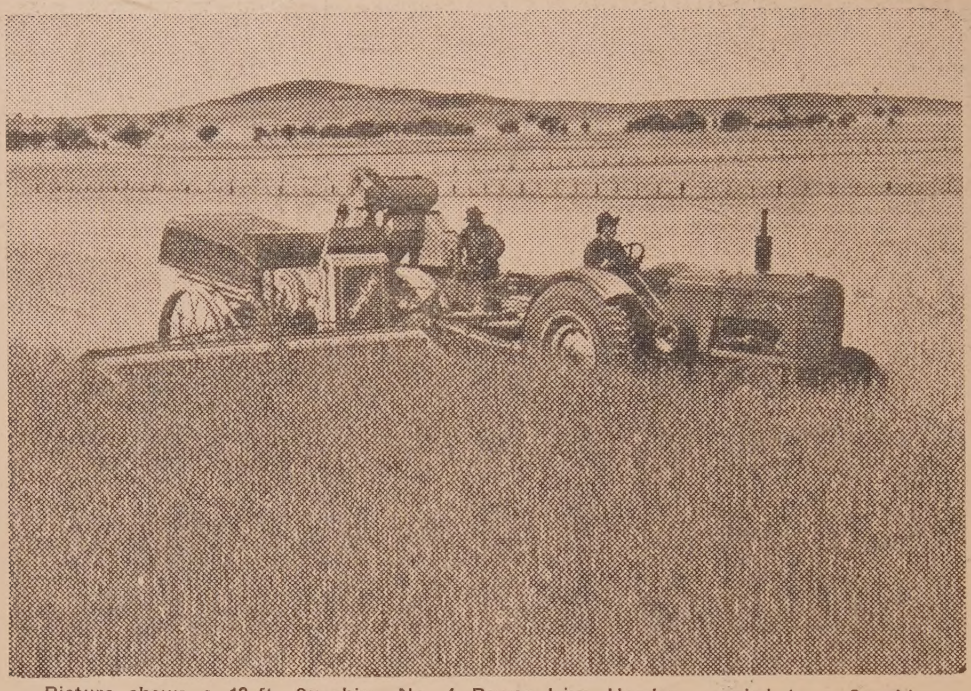
The Journal of THE AUSTRALIAN INSTITUTE OF AGRICULTURAL SCIENCE

COMMONWEALTH MYCOLOGICAL INSTITUTE
21 FEB 1949

VOL. 14 DECEMBER, 1948 No. 4

REGISTERED AT THE GENERAL POST OFFICE, SYDNEY, FOR TRANSMISSION BY POST AS A PERIODICAL



Picture shows a 12-ft. Sunshine No. 4 Power-drive Header, coupled to a Sunshine Massey-Harris Tractor, harvesting a splendid crop of Magnet wheat.

Sunshine Harvest Machinery

Headers and Harvesters for grain; Binders, Mowers, Rakes, Sweeps and Balers for hay, designed for efficient and economical operation under modern power-farming conditions.

There is tremendous demand for Sunshine harvest machinery and all lines are booked out for 1948. Orders are being taken for earliest possible delivery. See your local Sunshine agent at first opportunity regarding your machinery requirements.

H. V. McKay Massey Harris Pty. Ltd.
SUNSHINE HARVESTER WORKS, SUNSHINE

The Journal of THE AUSTRALIAN INSTITUTE OF AGRICULTURAL SCIENCE

Vol. 14 **No. 4**

DECEMBER, 1948

Editor:

A. SHAVITSKY, B.Agr.Sc.
University of Melbourne.

Business Manager:

W. J. WEBB, B.Sc.Agr., B.Ed.
C/o I.C.I.A.N.Z.,
380 Collins Street, Melbourne.

Assistant Business Manager:

P. T. MITCHELL, B.Agr.Sc.
C/o Department of Commerce and Agriculture,
301 Flinders Lane, Melbourne.

Publications Committee:

J. A. Baker, B.Agr.Sc.
R. D. Croll, B.Agr.Sc.
H. C. Forster, M.Agr.Sc., Ph.D.
N. S. Noble, D.Sc.Agr., D.I.C.

Contents

	Page
ARTICLES—	
Recent Developments in Animal Breeding, by Professor J. L. Lush	158
The Commonwealth Agricultural Bureaux, by A. B. Cashmore	162
With U.N.R.R.A. in China, by A. H. Bishop	167
TECHNICAL PAPERS—	
Carotene Losses in Curing and Storing Cereal Hay, by E. J. Underwood, R. G. Coleman and R. D. Curnow	175
Some Responses in Lettuce to the Application of Molybdenum, by R. D. Wilson	180
REVIEWS—	
Hormones and Horticulture	189
The Soil and the Plant	190
Fertilisers and Manures	190
The Use of Auxins in the Rooting of Woody Cuttings	191
Principles of Food Freezing	191
DIGESTS—	
Noogoora Burr in Relation to the Wool Industry	192
Sugar Culture in Hawaii	193
The Loss in Soil Fertility in New South Wales as Reflected by Wheat Quality	194
INSTITUTE AFFAIRS—	
Thirteenth General Meeting	196
Council Proceedings	197
Branch Notes	198
GENERAL—	
Specialist Conference in Agriculture	201
The Sutton Prize in Agriculture	201
Retirement of Dr. G. L. Sutton	202
PERSONAL	203
LETTERS—	
C.S.I.R. and Defence Research	194

STATE SUB-EDITORS:

A.C.T.: G. A. H. Helson, M.Sc.
N.S.W.: S. M. Sykes, B.Sc.Agr.
Q'land.: C. G. Hughes, B.Sc.Agr.
Sth. Aust.: A. J. Millington, M.Sc.(Agric.)
Tas.: T. D. Raphael, M.A., Dip.Hort.
Vict.: A. J. McIntyre, M.Agr.Sc.
West. Aust.: E. R. Watson, B.Agr.Sc.

Published Quarterly. *Annual Subscription Rate: Within Australia* 10/6, *British Countries* 11/6, *Foreign Countries* 12/6.

ARTICLES

RECENT DEVELOPMENTS IN ANIMAL BREEDING

By PROFESSOR J. L. LUSH

While the principles involved in animal and plant breeding are essentially similar, there is a current impression that plant breeding has progressed further than animal breeding. Whatever truth there may be in this can largely be attributed to the less advanced state of plant breeding in 1900, in which year Mendel's laws were rediscovered. Mendelian theory in many cases merely explained what had long been known in plant and animal breeding, but had previously seemed mysterious. Mendelism, however, supplies of itself few useful new tools for breeding. The development of animal breeding and genetics from 1900 to the present time has been gradual, the change at any instant being almost imperceptible, but in total, very important. During this period, perhaps, the most conspicuously successful tool which resulted from genetical theory, and which could not have been discovered by trial and error, was the inducing of hybrid vigour (heterosis) by making and testing inbred lines.

Three Aspects of Genetics

Genetics as a whole may be considered under three headings:—

1. *Physical Genetics*

This aspect is concerned with the physical basis of the laws of inheritance, and, of course, embraces cytology, Mendelian ratios, segregation, etc. It would appear that this aspect of genetics is by now fairly well explored and understood. It seems unlikely to produce in the future any fundamentally new concepts.

2. *Physiological Genetics.*

This covers the chemistry of genes and the mechanism by which they bring about their effects. It is the least known field of genetics and is now receiving much attention. The search at present centres on tools for investigating these problems. Workers in this field are now concentrating on what appear to be simplified cases such as yeasts, bacteria, mould, and other relatively primitive organisms.

3. *Population Genetics*

This category covers the study in a statistical sense of the characteristics of populations and how they change. A population may be a broad group or a narrow one, such as a species, a whole breed, a division of a breed, or even a single, herd or flock. As is well known, it is not possible to alter the genetic constitution of a given individual but it is possible to alter the characteristics of later generations of a population.

The "inward" composition of a population is determined by the kind of genes present, the frequency of such genes and the mating system which produced the population. The "outward" composition of the population is the inward one plus modifications by environment. It is important to stress that the sampling nature of inheritance maintains the genetic

PROFESSOR J. L. LUSH, Ph.D., who is Professor of Animal Breeding at the Iowa State College of Agriculture, U.S.A., recently visited Australia at the invitation of the Council for Scientific and Industrial Research. The above is a summary of his address to the Victorian Branch of the Australian Institute of Agricultural Science, delivered on September 28, 1948, and has been edited by him.

variation of the population at a nearly constant level unless extreme mating systems are followed. Most of the surprises in inheritance arise from such sampling and recombination, while mutations are rather rare and they almost always produce harmful characters. The importance of mutation increases as the time scale elongates and cannot be ignored in evolution with as little error as in problems of practical plant and animal breeding.

A Practical Example

Let us consider a practical case. Suppose we want to analyse the significance of data relating to the butterfat yield of a number of cows, all of which are daughters of the same bull. To do this we partition, as far as possible, the factors concerned into the following groups:

1. *Genic* differences, i.e., those that result from genes alone.
2. *Genetic* but not inherited differences (generally termed "nicking"). These differences result from the interaction of genes.
3. *Environmental* differences.

The actual example serves best to illustrate the procedure. This group of cows by the same bull was sorted on their first lactations into two equal groups, one containing the higher yielders and the other containing the lower yielders. The difference between the averages of the first lactations of the members of two groups was 102 pounds of butterfat. At the next lactation of the same cows, the difference was 44 pounds. The daughters of these same groups of cows showed an average difference of 14 lbs. The best available statistics from these data giving the proportion of variation attributable to the three categories above are as follows:—

(1) Genic difference equals

$$\frac{2 \times 14 \times 100}{102} = 28\%.$$

The factor 2 is appropriate because the sire was equally represented in the two groups and this would make the difference between the daughters only half of the genic difference between their dams. This percentage is known as the heritability. Progress from one generation of selection is given by the formula (reach X heritability).

(2) Environmental difference is best estimated as—

$$\frac{(102-44) \times 100}{102} = 57\%.$$

(3) Genetic but not inheritable difference=15% by difference. Part of this may really have been caused by permanent environmental effects but some could be due to dominance and some to epistasis.

A similar experiment was with the fleece-weight of sheep giving a difference of three pounds when sorted on their first fleeces into a high half and a low half. The second clip difference between these same groups averaged only about two pounds. The groups of lambs from these two groups of parents differed by about one pound, the rest of the two pounds being largely classified under the heading of "genetic but not inheritable."

Improvement of Genic Composition of a Population

Neglecting the "genetic but not inheritable" aspect, it is interesting to consider the best ways of improving the genic composition of the population. One way is by mass selection where the individual is selected with correction for environment if possible. The method of pedigree breeding enables a guess to be made about the genetic constitution (genotype) of the individual as an aid to selection by making similar guesses about genotypes of the individual's ancestors. Unfortunately for the purely logical approach, pedigrees available usually give only the favourable information and are likely to state that in the most favourable language. The very human foible of re-

membering only the good things in the pedigrees is a serious obstacle to the usefulness of pedigree selection.

Methods of Selection

Selection may be done on a number of bases, thus:—

(1) The individual's observable characters (phenotype),

(2) Ancestors,

(3) Sib selection.

Sib is merely an ancient but convenient term to mean sisters or brothers or brothers and sisters of the individual or individuals concerned. Selection or rejection on the basis of what the sibs are like is often a very useful method since results may be obtained at an early period, timing nicely with when the decision to select or to cull must be made. Useful special applications of this test are in connection with the measurement of "all-or-none" factors, such as when the test involves death of the test-animal, e.g., the determination of disease resistance and dressed weight. In the Danish system of pig breeding for carcase qualities, four pigs, sibs to the ones one may be considering saving for breeding, are killed and examined.

(4) Progeny selection.

Selection on the basis of progeny testing can be more accurate than the other three methods described, but a considerable number of years must elapse (a dairy bull must be at least six to seven years old) before the resulting data can be applied. By this time the sires and dams under test are relatively aged and have had considerable opportunity of imprinting characters on the group. Progeny testing is usually used only on animals which survive culling on bases 1 and 2 and preferably on basis 3 as well.

The breeder is very prone to think that his selection and culling are much more intense than they actually are. It is instructive, if possible, to compare the population average of the culls for the factors under discussion with the average of the selected flock. A personal experience in which large litter size in pigs was being sought showed that despite an impression that culling was rigorous, the actual selection was only a difference of a mere .03 of a pig per litter between offspring kept for a second litter and those which left the herd after only one.

Some Genetic Phenomena

Dominance is usually accorded too much importance. However, over-dominance is capable of having a great effect on a selection programme. It is as yet uncertain how much over-dominance occurs but the heavy decline which usually occurs with inbreeding in naturally crossed organisms indicates that over-dominance may be relatively common. The following over-simplified table shows how intensifying selection in the presence of over-dominance could actually lower the population average if the heterozygote is superior to both the homozygotes, but the latter are unequal to each other.

Gene Constitution	Hypothetical Potential of the Combination	% in population after natural selection has operated	% in population after selecting for highest exhibition of factor
Aa(heterozygote)	12	32	50
AA(homozygote)	10	64	25
aa(homozygote)	4	4	25
		100	100
Population Average		10.4	9.5

Such a situation is handled (where reproductive rates will permit that) by retaining pure seed stocks of AA and aa constitution and crossing these to produce the commercially useful Aa's.

Another factor disturbing straight-forward procedure is that certain genes may depend for their effect on the company they keep. Thus a gene causing increased thickness of back-fat in baconers is a desirable gene to introduce into a pig with thin back-fat, but is an undesirable gene in a pig with back-fat already too thick. Since the market ideal is obviously intermediate for many quali-

ties and may be so for many others where the relation is not so obvious, this may be an important aspect of practical breeding problems. In such an instance line breeding offers a possible way out. One would line-breed at least mildly and would out-breed only when that may be necessary to correct some defect which could not possibly be corrected while staying within the line.

Hybrid Maize Development

The development of the hybrid maize seed production scheme presents an interesting story. The idea was conceived in 1909, but not brought to profitable commercial practice until near 1930. The specific process is to develop by inbreeding as many lines as can be tested. The main part of the test is to cross them with each other and judge them by the characteristics of their crosses, rather than by their own. Four of these which cross well with each other are then crossed to produce the "hybrid" seed which is sold to the farmer. The latter profits by its increased vigour. At least as early as 1935 the question of doing something of this kind in animals was seriously tackled. It has now achieved economic success with fowls. The procedure has strong advantages in producing heterosis and lower mortality. For the breeder it has the commercial advantage of ensuring his monopoly of given strains and crosses. Breed crosses are usually involved also, so that the usual heterosis from cross-breeding is added to that from crossing selected inbred lines. This latter point deters poultrymen who like uniformity of appearance, from breeding from the chicks.

With pigs a modification of this system has also been tried with a less certain degree of success. The system used is rotation cross breeding which is actually a cyclic use of successive sires from distinctly different lines and crosses. With as many as three or four lines in the rotation this would be expected to give approximately 90% of the complete heterosis which could be had if the maize pattern could be followed, as it can be with fowls. It is considered improbable that such systems will be economically profitable with animals less prolific than the pig.

In conclusion it may be said that we have arrived at what might be termed the "engineering phase" of breeding where the costs of many of the known procedures can now be balanced against their probable returns. An example is the accuracy possible by trap-nesting hens for relatively few days per week:—

1 day per week—78% as accurate as 7 days a week.

2 days per week—90% as accurate as 7 days a week.

3 days per week—93% as accurate as 7 days a week.

Hence, if a poultryman can trap three times as many birds two days a week as he could trap seven days a week and thus would need to save only one-third as large a fraction, the gain from the extra intensity of selection would much more than overcome the slight loss in accuracy.

(*Received for publication*, 21*st October*, 1948.)

THE COMMONWEALTH AGRICULTURAL BUREAUX

By A. B. CASHMORE

One of the most difficult problems of the agricultural undergraduate, research worker, and extension officer nowadays is that of coping with the mass of literature which is presented for his digestion. To meet this problem abstracting services have been built up in recent years to present new information in readily accessible form—by publishing abstracts of useful papers in such a way that the importance of each is clearly indicated and sufficient information from the papers is given to meet the needs of the generality of workers in the field covered. An essential feature of such a service is that a complete coverage of world literature is obtained. Pre-eminent among these abstracting and information services in agriculture is the British Commonwealth Agricultural Bureaux organisation, and Australian agriculturalists can be proud that this country is a contributor to this original intra-Commonwealth organisation.

History

The first step towards meeting the need for an effective information service in agriculture in the Commonwealth was taken in 1909 when the Entomological Research Committee (Tropical Africa) was formed and action taken to send entomologists to East and West Africa to collect and study insects injurious to man, animals, and crops in those regions. The Secretary of the Committee, located at the Natural History Museum, South Kensington, arranged for the identification of insects received from the field workers and kept them supplied with information on all developments bearing on their work. In 1911, it was proposed and agreed that this service should be extended to other Commonwealth countries and that a monthly periodical should be issued giving summaries of all current literature dealing with noxious insects. The Committee of Management was enlarged and the financial budget increased, each government contributing. In January, 1913, the Review of Applied Entomology appeared—the first Bureau abstract journal.

The next step was taken when the Imperial War Conference of 1918 approved a proposal to form an Imperial Mycological Bureau similar in functions, control, and methods of finance to the Bureau of Entomology. This new Bureau was founded at Kew in 1920, and its abstract journal, the Review of Applied Mycology, first appeared in January, 1922. The functions of the new Bureau were defined as:—

1. To collect and disseminate information regarding applied mycology and plant pathology;
2. To identify and study fungi of economic importance;
3. To arrange periodical meetings of mycologists and plant pathologists of the Empire;
4. To maintain a lending library for the use of Empire workers;
5. To assist in the framing of legislative measures for quarantine and to issue warnings of the occurrence of diseases;
6. To assist in the publication of papers by overseas workers;
7. To promote a survey of the fungi and plant diseases of different parts of the Empire, especially of the tropical countries;

A. B. CASHMORE, M.Sc., is liaison officer in Australia for the Commonwealth Agricultural Bureau.

8. To provide facilities for overseas mycologists to work in the Bureau and to aid them in arranging study tours elsewhere;
9. To maintain a card index of the fungi recorded on tropical and other crops;
10. To keep in touch with manufacturers of spraying apparatus and materials, to aid in getting these tested, and to act as a liaison organisation with overseas mycologists in this respect;
11. To facilitate the exchange of material for study;
12. Generally to do anything within its province that it is asked to do by overseas Empire workers.

A further development occurred when, at the Second Imperial Entomological Conference held in London in June, 1925, the following resolution was adopted:—"The Conference accepts the principle that the Bureau (of Entomology) should arrange for the export to overseas governments of beneficial parasites." This was the origin of the Farnham House Laboratory, an organisation which has, since 1947, become the Bureau of Biological Control. The Laboratory was founded in 1927 with a grant from the Empire Marketing Board. The finance needed to maintain the Laboratory was obtained in part by charges against governments for specific work done on their behalf.

The work of the two Bureaux was so useful and met such a real need that the 1927 Imperial Agricultural Research Conference recommended the establishment of centres for the interchange of information in eight other subjects. These subjects were to be:—Soil Science, Animal Health, Animal Nutrition, Animal Genetics, Plant Genetics, Pastures and Forage Crops, Horticulture, and Agricultural Parasitology. It was decided that these eight new Bureaux would not undertake research work themselves but would be located at research institutes at which work in the particular subjects was in progress. Institutes in the United Kingdom were selected because scientists from overseas visited the United Kingdom more frequently than any of the other Commonwealth countries. An organising committee was appointed in 1928 to define the functions of the new Bureaux, to advise on their location, the finances needed, the shares in which that finance should be provided by the co-operating governments, and to devise for their day to day administration a new form of Commonwealth agency consonant with the principles of equality laid down by the Imperial Conference of 1926 in its resolution on Dominion status.

The eight Bureaux were to be financed from one common fund provided in agreed proportions by the various governments and administered by an Executive Council to which each Government nominated one of its officers as a member. Through these members the Executive Council became responsible directly and equally to all governments and was not under the supervision of any one minister of any one government. The Executive Council was appointed on April 1, 1929, and the eight new Bureaux were founded in the following few months. The purpose of the new Bureaux was defined as:—"The purpose of the Imperial Agricultural Bureaux is to act as effective clearing houses for the interchange of information of value to research workers in agricultural science throughout the various parts of the Empire." These arrangements did not affect the two previously established Bureaux except that, because they undertook scientific investigations in addition to acting as information centres, they thereupon took the title of "Institutes."

Close Commonwealth Relations

In order to encourage close relations among specialists generally, senior entomologists and mycologists in Commonwealth countries had been made members of the Committees of Management of the

Institutes. For a similar purpose each overseas government nominated one of its scientific officers to be "Official Correspondent" in that country for each Bureau. He was to act as the "general friend" of the Bureau, was to be kept advised of its activities, and was to bring to its notice any suggestions made for improving its services. In addition each overseas government appointed a liaison officer to represent the secretary of the Executive Council in an administrative capacity in that country.

The Empire Committee on Economic Consultation and Co-operation was appointed in 1933 to examine the work and organisation of a number of imperial organisations. This Committee approved of the Executive Council and its method of working as an intra-imperial agency. It also approved of the work of the Bureaux. On constitutional grounds it recommended the transfer to the Executive Council of the administration of the Institutes of Mycology and Entomology. It also laid down that the work of imperial agencies organised like the Executive Council should be subject to "careful and periodical examination at Empire conferences suitable for the purpose." The British Commonwealth Scientific Conference of 1936 made the first of these periodical examinations. It recommended several improvements in the working of the Bureaux, approved of the Bureau of Animal Nutrition covering the literature on human nutrition, and recommended the establishment of two new Bureaux to deal with Dairy Science and Forestry. These new Bureaux were founded and their journals, Dairy Science Abstracts and Forestry Abstracts, first appeared in 1939. The 1936 Conference also recommended that the Farnham House Laboratory be maintained on an intra-imperial basis and that finance should be provided by governments to cover maintenance and the retention of a nucleus of the staff. In 1940, Farnham House Laboratory was closed and the headquarters moved to Canada. The publication of a Parasite Host Catalogue was first undertaken there in 1943.

Agricultural Collections

A further responsibility of the Executive Council of the Commonwealth Agricultural Bureaux is the Potato Collection which is maintained at Cambridge in association with the Bureau of Plant Breeding and Genetics. This collection had its origin in a suggestion made at the meeting of the Imperial Council of Agricultural Research held in India in 1932. Subsequent to this meeting the governments of the Commonwealth agreed to finance jointly an expedition to Mexico and the Andes to collect wild and cultivated types of potato. The first expedition visited Mexico in 1938 and the second South America in 1938-39. The collection has since been augmented from many sources and work, now on some 1,500 lines, is in progress to determine the breeding characteristics of this material in relation to the possible improvement of cultivated potato varieties for disease resistance and use in areas previously considered unsuitable for potato production. The collection is maintained financially by contributions from the governments of the British Commonwealth and material is made available to plant breeders on request. Greenhouse and laboratory accommodation was provided in 1946 from a grant made by the Nuffield Foundation.

The second periodical examination of the work of the Executive Council was made at the Imperial Agricultural Bureaux Review Conference in 1946. The Conference approved the work of the Bureaux and endorsed the action taken by the Executive Council in implementing the recommendations of the 1936 Conference. It recommended the change of name of the parasite service to that of the Bureau of Biological Control, that its headquarters should remain in Canada, and that it should be fully maintained by government contributions; that the

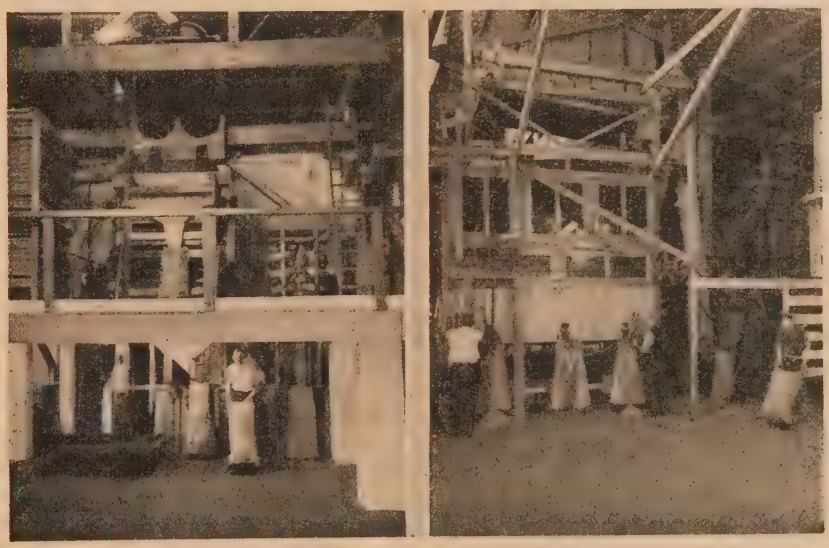
BRUNNINGS

SEEDS FOR SOWING

F. H. BRUNNING PTY. LTD.

Since 1852 our trading policy has been based on the supply of choicest quality Pasture Grasses and Clovers, with utmost attention to each consignment for prompt despatch.

Nearly one hundred years ago our warehouse operations were organised for what was efficiency in those far-off times. Since then we have continued to avail ourselves of scientific developments, thus making possible the uniform high standard of Brunning's seeds.



Portion of Brunning's Cleaning Equipment.

Write to Box 875K G.P.O. Melbourne

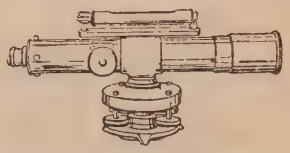
For all Pasture and Farm

SEEDS FOR SOWING

Reg. Office: 57 Elizabeth Street, Melbourne.
Telegrams: "Myosotis," Melbourne.
Phone: MB 1661, MB 1662.
Warehouse: 22 Hanna Street, South Melbourne.

SCIENTIFIC & OPTICAL INSTRUMENTS

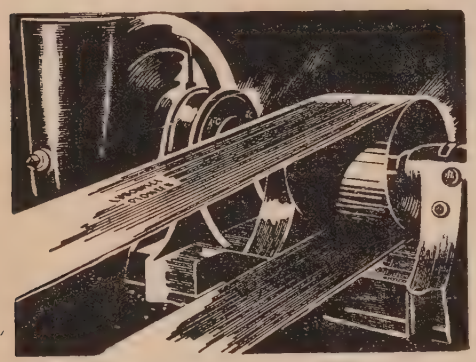
Surveying, Engineering and
Drafting Equipment,
Microscopes & Accessories, Scientific Books.



PRICE LISTS ON REQUEST

N. H. SEWARD PTY. LTD., 457 BOURKE STREET, MELBOURNE MU 6129.

LUDOWICI LEATHER BELTING



We also specialise in Mechanical Leathers for all purposes, Gears, Pulleys, Bearings, Shafting, Hangers, Pivot Drives, Catalogues on request.

It is not by chance that the largest industrial undertakings in Australia use Ludowici Leather Belting. It is the result of years of experience which has proven the greater dependability of Ludowici Pioneer Leather Belts on every type of drive.

We have a specially made belt for your requirements and guarantee long life and full power transmission under all conditions of service.

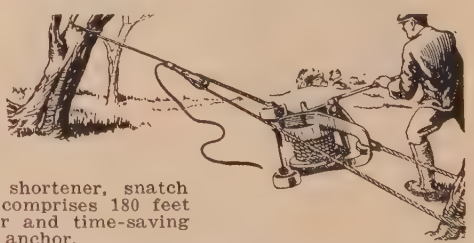
Without obligation, our Engineers will advise you on your particular power transmission problems.

J. C. LUDOWICI & SON LTD.

117 York Street, Sydney. 20-26 Queen's Bridge Street, South Melbourne

Getting Rough Jobs Done is the Whole Function of the

"Monkey" Grubber



In the "Monkey" Grubber way clearing work is done expeditiously and without great outlay, leaving land ready for mechanical tilling. The machine delivers 260 times the power applied to the handle. It is portable and fitted with an automatic lowering gear, second speed, rope shortener, snatch block, etc. Cable equipment is generous and comprises 180 feet in four lengths each fitted with special labour and time-saving couplings. Takes an acre and a half from an anchor.

TREWHELLA BROS. PTY. LTD., Trentham, Victoria

Bureau of Soil Science should cover agricultural climatology in addition to soils and fertilisers; and that a Plant Expeditions Committee should be set up to receive information and to advise on such expeditions and the maintenance of plant collections. Since the Review Conference the title of the Bureau of Pastures and Forage Crops has been changed to that of the Bureau of Pastures and Field Crops and a new journal, "Field Crop Abstracts," was produced in 1948.

Change of Name

On January 1, 1948, the name of the organisation was changed from "Imperial Agricultural Bureaux" to "Commonwealth Agricultural Bureaux." This change was made to meet the wishes of certain British Commonwealth countries and because the designation "Commonwealth" was considered more in keeping with modern trends. The change has caused a good deal of confusion in Australia where the title "Commonwealth" is used so widely to indicate Federal instrumentalities.

Services Provided

The organisation provides the following services:—

1. The Executive Council publishes the "List of Research Workers Agriculture and Forestry in the British Commonwealth" and is represented on the committee of management of the Journal of Dairy Research. The Secretary to the Council is represented in Australia by the Liaison Officer.

2. The Commonwealth Institute of Entomology undertakes the identification of insect specimens and publishes the Bulletin of Entomological Research and the Review of Applied Entomology, Series A (agriculture, forestry and storage) and Series B (medical and veterinary). Official Correspondent for the Institute in Australia is Mr. J. H. Smith, Department of Agriculture and Stock, William Street, Brisbane.

3. The Commonwealth Mycological Institute publishes the Review of Applied Mycology and is responsible for certain investigational and identification work in the field of general mycology. Dr. C. J. Magee, Department of Agriculture, Box 36A, G.P.O., Sydney, is Official Correspondent for the Institute.

4. The Commonwealth Agricultural Bureaux, together with their Official Correspondents and abstract journals, are listed below:—

i. The Bureau of Soil Science at the Rothamsted Experimental Station, publishes "Soils and Fertilisers." Professor J. A. Prescott, C.B.E., Waite Agricultural Research Institute, Private Mail Bag, Adelaide, is Official Correspondent.

ii. The Bureau of Animal Health, at the Veterinary Laboratory, Weybridge, publishes "The Veterinary Bulletin." Dr. L. B. Bull, C.S.I.R. Division of Animal Health and Production, Parkville, N.2, Victoria, is Official Correspondent.

iii. The Bureau of Animal Nutrition, at the Rowett Research Institute, Aberdeen, produces "Nutrition Abstracts and Reviews." Official Correspondent is Mr. H. R. Marston, C.S.I.R. Division of Biochemistry and General Nutrition, University, Adelaide.

iv. The Bureau of Plant Breeding and Genetics, at Cambridge, publishes "Plant Breeding Abstracts." Professor H. C. Trumble, Waite Agricultural Research Institute, Private Mail Bag, Adelaide, is Official Correspondent.

v. The Bureau of Pastures and Field Crops, at Aberystwyth, publishes "Herbage Abstracts" and "Field Crop Abstracts." Official Correspondent is Dr. J. Griffiths Davies,

C.S.I.R. Division of Plant Industry, P.O. Box 109, Canberra City.

vi. The Bureau of Horticulture and Plantation Crops, at East Malling Research Station, publishes "Horticultural Abstracts." Official Correspondents are Mr. F. M. Read, Department of Agriculture, Treasury Gardens, Melbourne, C.2, and Dr. W. A. T. Summerville, Department of Agriculture and Stock, William Street, Brisbane.

vii. The Bureau of Animal Breeding and Genetics, at Edinburgh, produces "Animal Breeding Abstracts." Official Correspondent is Dr. R. B. Kelley, McMaster Field Station, C.S.I.R. Mail Bag, Liverpool, N.S.W.

viii. The Bureau of Agricultural Parasitology (Helminthology), at St. Albans, publishes "Helminthological Abstracts." Mr. H. McL. Gordon, McMaster Animal Health Laboratory, Parramatta Road, Glebe, N.S.W., is Official Correspondent.

ix. The Bureau of Dairy Science, at Shinfield, near Reading, produces "Dairy Science Abstracts." Dr. W. J. Wiley, Commonwealth Dairy Expert, 301 Flinders Lane, Melbourne, is Official Correspondent.

x. The Commonwealth Forestry Bureau, at Oxford, produces "Forestry Abstracts." Official Correspondent is Mr. D. A. N. Cromer, Forest Resources Division, 82 Pitt Street, Sydney.

xi. The Bureau of Biological Control, at Ottawa, Ontario, Canada, does not publish an abstract journal. Mr. Frank Wilson, C.S.I.R. Division of Economic Entomology, P.O. Box 109, Canberra City, is Official Correspondent.

5. The Potato Collection is a unique collection of genetic material available to plant breeders in the British Commonwealth. It is maintained at Cambridge where intensive work is in progress to determine the breeding characteristics of the many lines held.

6. Publications of the Institutes and Bureaux are not restricted to abstract journals. Reviews, technical communications, and occasional papers on subjects of current interest are also produced. Where two or more Bureaux collaborate in the preparation of reviews the papers appear in the Joint Publications series. The Bureau of Biological Control is concerned, in the publications field, only with the production of "A Catalogue of the Parasites and Predators of Insect Pests." Lists of all C.A.B. publications are available in the "List of Research Workers Agriculture and Forestry in the British Commonwealth 1947," on pages 317 to 333.

The main impression one receives as a visitor to C.A.B. centres in the United Kingdom is the unfailing courtesy, goodwill, and helpfulness of all members of the organisation, from Sir Herbert Howard, Secretary to the Executive Council, and Directors of Institutes and Bureaux to the most junior abstractors and typists. The main complaints that C.A.B. staff members have are insufficient contact with research workers in the Commonwealth generally and too little use of the Bureaux by overseas workers. It is not generally realised in Australia that these Bureaux are British Commonwealth centres and not purely United Kingdom Bureaux and that a function of the Institutes and Bureaux is to supply, to research workers in the Commonwealth on request, information, including bibliographies, on specific problems.

(*Received for publication, 15th October,* 1948.)

WITH U.N.N.R.A. IN CHINA

By A. H. BISHOP

This paper is presented firstly, from the point of view of an agriculturist who is interested in the agriculture of a foreign country; secondly, with reference to the impact of U.N.R.R.A. on the political and social background of China, and finally to draw conclusions as to the present-day place of international agricultural organisations in world affairs.

China Background

The Chinese are a very distinct and homogeneous people, and this quality is related to the topographical unity of China. It is a large tract of land including rich agricultural plains bounded on one side by the sea, and on the other sides by almost inpenetrable mountain barriers. From these mountains flow immense river systems which water the plains which form the major agricultural areas.

First, there is the Manchurian plain which is immense in area and has only recently been developed agriculturally. Then the north China plain, which extends from Peiping and Tientsin down to the Yellow River and then south to link up with the great alluvial plain of the Yangtse Valley. In the south, there are further alluvial plains, and in Central China the plains of Hunan and Szechwan. In addition, the mountain areas of Shantung and Central China and South-West China are developed agriculturally.

Climatically, China is characterised by extreme differences between winter and summer. The climate is dominated by the prevailing winds which, in the winter, come out of the inland mountains and Siberia; and in the summer out of the South China sea. The result is that in North and Central China, the winter is dry and cold, and in Manchuria it is desiccating and so very cold that nothing grows. The summer is moist and hot and, even as far north as Manchuria, rice, tobacco and soya beans are grown.

As a result of the interaction of climate and soil types, China falls into well-defined agricultural regions. These have been classified by J. L. Buck in his "Land Utilisation in China," who describes the following areas:—

Spring wheat
Millet wheat
Kaoliang wheat
Rice wheat
Rice tea
Double cropping rice
Szechwan rice
South-western rice.

I will deal only with those areas of which I saw a complete agricultural cycle.

The Rice-Wheat area comprises the broad and extensive Yangtse River Valley. The soils are mainly deep, black, rich alluvium of the Yangtse flood plain. The area is a complete network of canals which serve for irrigation, drainage, and transportation of agricultural products.

The main food-producing crop is rice, which is planted in May and June, and harvested in October and November. The fields are ploughed usually by water buffalo and then flooded. The remaining preparation is done under water until an even deep mud is produced. The rice is planted by hand as seedings six to ten inches high in rows about nine inches

---

A. H. BISHOP, B.Agr.Sc., who was formerly an officer of U.N.R.R.A. in China, will shortly be taking up a soldier settlement block near Penshurst. *This paper is based on an address to the Melbourne University Agricultural Society on 10th May, 1948.*

each way. Cultivation is done by hand-hoes between rows. Irrigation is done by raising water from the canals by primitive elevators operated by buffalo or ox, or by groups of men, women and children working treadmills attached to elevators. The crop is harvested by sickle and stacked on the check banks to dry and then carried to the threshing floor.

As soon as the land has drained, it is ploughed and sown to wheat. The wheat grows through a fairly dry winter and is harvested in early summer. Two-thirds of the crop area receives a second crop each year. Other crops grown are broad beans, rape, vegetables and some maize.

The Wheat-Kaoliang area covers the North China plain extending from the northern border of the rice-wheat area to Peiping and Tientsin. It includes also the mountain area of Shantung peninsula. The soil of most of this vast area is Yellow River alluvium, which has well-defined characteristics. It is of wind-blown origin derived from vast mountainous area of loess within the bend of the Yellow River, which has been elevated and dissected by innumerable rivers in deep gorges. The soil is very fine, consisting of a fine silt clay and a very fine sand fraction, and the Yellow River normally carries twenty per cent. by weight of this material when in flood. Figures up to forty-four per cent. by weight have been obtained under peak flood conditions. When the river breaks its banks, deep deposits are left. The silt makes good agricultural land, although fresh deposits are deficient in nitrogen for the first year.

The main food-producing crop in this area is wheat, which is planted in October to November, and harvested in May. Kaoliang is a grain sorghum, growing eight to ten feet high. It is used for food and also for spirit, while the stems are used for housing and fuel. It is planted in the early spring, not directly following wheat. After the wheat crop planted to catch the mid-summer rains comes off, an array of summer crops is which follow a dry winter and spring. These crops are mainly legumes, such as mung beans, soya beans, black eye beans; and also maize, melons, and in some parts, cotton.

To be in Honan at the time of the wheat harvest is an amazing experience. The countryside, which is in wheat up to the end of May, is then harvested and replanted to summer crops within two or three weeks, and by the end of June these are growing vigorously under the summer rains.

A brief statistical survey will help to picture conditions of the average Chinese farm.

The size of the average Chinese farm is five and a half acres in the wheat region, and three and a half in the rice region. This land is not all in one place, as the average farm has fields in five or six different locations. Thus, the farmer has to walk as far as if he had a six hundred acre block. In the rice growing areas of south China, fifty per cent. of the farm land is irrigated, and in the wheat region fifteen per cent.

"Natural calamities" is an item of statistics given by John Lossing Buck. For the Wheat-Kaoliang area he records four to five floods and nine droughts in twenty-five years. He also records the frequency of "Famines when infanticide is practised," which, in some areas, occurred more than once in twenty-five years. The percentage of crop area receiving a second crop each year is thirty-nine per cent. in the wheat region and sixty-five per cent in the rice region. Livestock statistics show an average of 1.1 animal units per farm made up of .23 water buffalo, .41 cattle, .5 pigs and 4 chickens.

The percentage of farms having one head of livestock is as follows:—

In the wheat region thirty-five per cent. of farms have an ox, thirty-nine per

cent. a donkey, and twenty-six per cent. a pig. In the rice regions thirty per cent. have a water buffalo, thirty-two per cent. have an ox, three per cent. a donkey, and fifty-seven per cent. a pig. The number of farms in China which have no work animals is thirty-five per cent. The farm area occupied by graves of forefathers is one to two per cent. Finally, the average size of a family is five and six persons.

These figures give only a rough background of the life of the average farmer in China. There are many things that a Chinese farmer has to contend with that are not understood in this country. I have quoted five to six as being the average size of family, and yet peasant women normally have fifteen to sixteen pregnancies during their lifetime. The remainder die of disease, starvation, or are even sold in bad times.

Some of the difficulties a Chinese farmer has to face are as follows:—

Disease: All Chinese children appear to have dysentry for the first three years of their lives. The survivors are not much troubled after that. Cholera, small pox, typhoid, and other scourges rage through the country periodically, and only in very few areas has any effort been made to control them.

Floods: Chinese rivers are notoriously dangerous and uncontrolled, and flooding is frequent over a large area.

Drought: The farms are cut down in size until the poorer farmers just have enough to subsist on in normal years. When drought comes, they suffer for long periods half nourished and eating grass and bark, etc.; or they are forced to migrate to a city to work as coolie labour.

Rent: Rents are enormous and usually taken in kind. Forty per cent. of each crop is quoted as an average and fifty to sixty per cent. very common. In addition, the farmer is liable for a large number of taxes.

Interest: When farmers get into debt, the interest load becomes immense. The Farmers' Bank charges twenty per cent. a month on cash loans, but this is largely due to inflation. However, loans of grain for seed received from landlords are frequently paid back plus one hundred to two hundred per cent. per annum.

The army is a scourge to the farmers. They normally live on the land by raising special taxes wherever they go. The traditional method of recruiting is to send soldiers into the fields and round up farm boys and tie them with ropes and march them off. Chiang Kai Shek is said to have recruited 12,000,000 in this way during the war. From my own experience, however, I am satisfied that the "Communist" armies are volunteers, and they pay for the food they take from farmers.

For the Chinese farmer there is no security against starvation, disease and abuse. From the time they are small, every Chinese child has seen in the street bodies of men who have died of starvation. The community as a whole does not care, and there is practically no community action against calamity. The result is that they turn to the family which sticks together for security, and makes a very strong unit in the community.

Historical Background

In order to understand the political background of China, it is necessary to consider the history of events leading up to the present state of civil war. It must be remembered that both sides in the present struggle derive from the revolution which took place in 1911. Following this event, in which the Empress was overthrown, Dr. Sun Yat Sen attempted to set up a republic. The country, however, fell back to war-lordism for many years. After the Great War, under Sun Yat Sen in Canton area, a revolutionary army was built up to defeat the war lords. By 1925, under the leadership of General Chiang Kai Shek, this army set out on

the northern expeditionary campaign. At this time, Sun Yat Sen died and the leadership of the entire movement fell to Chiang. Having captured Hankow, he closed in on Shanghai. The city was taken from within by unions which revolted.

Shortly after the capture of Shanghai, a split occurred in the party. In a purge of the left wing section, 10,000 labour leaders were executed. The survivors fled and set up the Chinese Communist Party which commenced working in opposition to Chiang. They moved into the province of Kiangsi and tried to set up a small Soviet on the Russian model. In their efforts to establish collective farms, they met with little success as it was opposed to the family outlook of the Chinese farmers.

In the meantime, Chiang, having got financial backing from local industrialists and foreign financiers, built up an army to defeat the Communists. A protracted war took place and eventually the Communists concentrated and broke through the cordon surrounding them. The long march began and continued for 8,000 miles of fighting rearguard actions. Eventually a few thousand survivors finished in Shensi, near Yenan, where they were able to halt and form a defence area. From this time onward they ceased to follow Russian methods, and applied the principle of Sun Yat Sen—"Land to the Tiller," to solve the problem of land tenure.

By this time the Japanese war was brewing, and Manchuria was under Japanese control, and further "incidents" in North China were frequent. Following a meeting of the leaders on both sides, the civil war was dropped and the country united to resist the Japanese.

In the early stages of the Japanese war, China achieved unity under the leadership of Chiang Kai Shek, and a determined resistance to the invader swept the country. Some heavy battles were fought but the Chinese forces were driven back to Central and Western China. During this period, the Communist armies were nominally under Chiang's command and things went moderately well until, in 1942, a force of 6,000 Communist troops were ambushed and destroyed by a Nationalist army. Following this, relations were strained and each side kept troops stationed on their common frontiers.

The tactics of the two armies were markedly dissimilar. Chiang kept his troops in large units under his command and threw them into very heavy battles. The Communists did not fight any major battles, but they dispersed their troops throughout the countryside behind the Jap. lines. There they built up resistance centres where farmers' militia were trained in guerilla work. These areas had an Administrator in charge of education and commerce. They used a "resistance currency" to combat the Japanese "puppet currency" and succeeded in leading the people in resisting the Japanese in every way.

When the war suddenly ended, there was a scramble to possess Chinese territory and Japanese arms. The Communists got more territory in North China because they were virtually occupying it; but with U.S. assistance, Chiang got most of the important cities. The largest airborne troop movement in history was the lifting of Chinese troops by U.S. planes to Mukden, Tientsin and Peiping. After a few months of skirmishing at the close of the war, a truce was secured on January 13, 1946, by the intervention of General Marshall. It was in this truce period that the United Nations' Relief and Rehabilitation Association operations got under way.

The Development of the U.N.R.R.A. Programme

The conception of U.N.R.R.A. was first approved at an international conference late in 1943. Within a year, planning staff had been established, and during

late 1944 and 1945 a team of experts, working at Chungking in consultation with Chinese officials, drew up the programme for China. In estimating war damage at a distance, and in drawing on vast international funds, it is only natural that the programme as planned was very generous in conception. The planners took a liberal view of the word "rehabilitation," because they included a large amount of equipment and supplies which had not been used in China before.

The operations in China were based on an agreement between China and U.N.R.R.A., known as the Basic Agreement. In formulating this agreement, difficulties occurred over one point which later, became the greatest stumbling block to the success and efficiency of the programme. Regarding distribution of supplies, Chiang Kai Shek insisted that this should be done by an agency of the Chinese Government. Any other arrangement, he insisted, would be an intolerable infringement of Chinese sovereignty.

The point was conceded and the supplies became the property of the Chinese Government when they passed over the ship's side. The U.N.R.R.A. staff was responsible for advice and assistance in distributing supplies and to see that the policies of the United Nations were not violated. The actual distribution was done by a Chinese organisation called C.N.R.R.A. An U.N.R.R.A. staff was built up of 1,400 personnel from overseas, plus a large number of locally employed Chinese and Europeans. C.N.R.R.A. expanded into an enormous organisation with branch offices in every province of occupied China.

Another part of the Basic Agreement was that the costs of C.N.R.R.A. operations and the local currency requirements of U.N.R.R.A. were to be paid by the Chinese Government. With the civil war taking up to eighty per cent. of the National income, it was almost impossible to get this money paid. C.N.R.R.A. ran on credit for months at a time, and finally obtained permission to sell certain classes of supplies to defray the costs. Before long C.N.R.R.A. was trying to sell everything, and it was a constant battle to ensure that some of the agricultural supplies were delivered free to the farmers.

When supplies started to come to hand, the port of Shanghai became completely congested. Up to one hundred ships discharging at once was normal, and the demand for wharfage, lighterage, stevedores, etc., was immense. Many C.N.R.R.A. and other government officials became immensely rich by getting control of these facilities and charging fantastic prices for the use of them. It cost as much to get supplies from Shanghai to Nanking as it did to get them from America. One estimate for the overall cost of distribution in China was 300,000 Chinese dollars per ton, then equal to £30 Australian.

Another great difficulty the U.N.R.R.A. programme had to face was the political background and civil war. According to the U.N.R.R.A. charter the goods were to be distributed according to need and without reference to politics or religion. According to war damage, the Communist areas in North China were entitled to fifty per cent. of the supplies. Plans were made to start deliveries, but as soon as supplies began to move, the Nationalist armies imposed a blockade. Arguments about this went on for months before the point could be settled. Chiang gave orders that supplies were to be permitted to pass, but at any time local commanders would stop movements as they liked. It was found that shipment by U.N.R.R.A. ships to Communist ports was the best way to get over the difficulty. After a service using army landing ships had become well established, an U.N.R.R.A. ship was bombed by a Nationalist plane. While this incident was receiving an official apology, another bombing took place in another port.

In the meantime, the civil war flared up when Chiang's troops, which had been fully equipped with United States arms and equipment, began attacking heavily. U.N.R.R.A. operations in several areas were withdrawn as unsafe. As a result of deliberate obstruction of C.N.R.R.A. staff and officials, plus the efforts of the Nationalist army and air force, the total deliveries to Communist territories reached just over one per cent. at the end of a year.

At this time there was a third change in direction of the mission, and a plan to impound undelivered supplies allocated to Communist territories was introduced. A large volume of goods was impounded under this scheme, but when the mission began to close down it was still undelivered and was handed over to the Nationalist areas.

Experience of U.N.R.R.A. Programme

In my own experience in the programme, I was fortunate in being assigned to interesting tasks, where it was possible to accomplish something.

My first assignment was as a conservancy engineer on the Grand Canal Project. The Grand Canal runs north from the Yangtse River to Peiping. It was built two thousand years ago to take rice to the court in Peiping. It crosses the natural river system and has completely altered the drainage of the coastal region of North China. The Canal is very important for irrigation of rice and as a north-south route for river transportation. The Canal is contained by dykes, and in the course of centuries it has been elevated by building up the dykes as silt is deposited on the bed. For this reason it is a great danger in case of flood in the very thickly populated area of the lower Yangtse valley.

During the war the annual repairs to the dykes had been neglected, and many of the locks and structures had been destroyed by the Japanese. The area had been the scene of much fighting, as Communist resistance centres had occupied the surrounding countryside. At the end of the war, it was included in one of their Border Region Governments.

Shortly after I started on this job, the Army closed the Canal to U.N.R.R.A. supplies. In order to provide an alternative route, it was necessary to inspect coastal harbours, which had not been used for twenty years, and then to persuade some C.N.R.R.A. official that it was a practical proposition to use them for shipping supplies. Every bit of paper work had to be pushed through many departments for innumerable signatures. We succeeded eventually in getting an L.S.T. despatched. Within six months three shiploads comprising 4,000 tons of supplies were delivered to this area. It was mostly food which was used to pay the labourers. Up to 40,000 workers were employed during the peak period. The labour was organised by the Communist Government, and I dealt with their chief engineer, who was a girl aged twenty-two years, who had studied engineering in Shanghai.

By the late summer, the work was well under way. The flood reached a very high level, only four inches below the peak year of 1931, but the dykes held. At the same time as the flood, however, came the civil war. Two columns entered the territory with strong air support. It was unsafe to drive a motor vehicle by day, and almost every town and many villages were bombed or strafed. The U.N.R.R.A. staff withdrew to three "safer" locations in succession, and eventually were evacuated by night in an L.C.M. down thirty miles of river, one bank of which was occupied by the Nationalists and the other by the Communists.

My next assignment was to work on the reclamation of the Yellow River flooded areas. This was an important

phase of one of the major tasks undertaken by U.N.R.R.A. The Yellow River is also elevated above its flood plain for a large part of its lower course. If the south bank is broken at Kaifeng, the river flows to the sea near Shanghai, whereas if the north bank is broken it flows out at Tientsin. In 1938, when a Japanese army was hard pressing a Chinese force, the Generalissimo ordered that the dyke be cut. It is typical of China that no one bothered to warn the three to four million people who were in the way. The Japanese were stopped, and up to four million acres of land was flooded.

The closing of the gap was given high priority amongst U.N.R.R.A. tasks. In 1946, the summer floods came before it could be finished, and the trestles washed away. It was finally closed in the following March after a long drawn-out bitter argument between the Nationalists and Communists, because by this time the new course of the river would be of great strategical value in the fighting in Shantung.

My task was to conduct a survey of the flooded area with a team of two soil men and two agricultural engineers. We spent three months covering four million acres, and produced a complete report on the condition and rehabilitation needs of the area. We found that a large part of the area had been planted for catch crops between the annual floods, and there was an appreciable area in crop when the gap was actually closed.

A large area which had a year before been a thick mass of willow seedlings six to ten feet high, had been cleared and sown to wheat. This work had been done mainly by hand labour while the twenty-nine farmers lived by transporting the willows twenty miles by wheelbarrow in exchange for food. A further large area had already been planted by returning refugees who seeded summer crops direct on the deposits of silt. There was still a considerable area under water, and other areas were in danger of being flooded again, because the immense silt deposits had disrupted the local drainage channels. The deposits of silt were extensive, being ten to fifteen feet deep and up to twenty miles wide for more than half the length of the flood channels.

We also found that a large part of the area was virtually a no-man's land between opposing forces in the civil war. In the closing months of the programme 30,000 tons of supplies were distributed in this area. Recent reports show that it is now nearly all in Communist control.

Experience of Communist Territories

My time in China was fairly evenly divided between Communist and Nationalist territory. I found the Communist territories were very well governed considering the development of the country.

The keystone of their policy is land reform, and this is the foundation of their strength because the farmers support them, and they are eighty per cent. of the population. The application of their policy has changed from time to time. During the war they did not interfere with landlords except to stipulate a maximum rent of thirty-five per cent. of the crop. After the close of the war in the areas where they were not worried by the civil war, they went a step further. They resumed the land of large landlords, and paid them for it, encouraging them to invest the money in industry and commerce. Additional land became available because they executed landlords who had collaborated with the Japanese, and many others fled into nationalist territory. It is true that they are hard on landlords as a class, but they made it a rule always to leave them enough land for a living. I met several ex-landlords in Communist territory who had no complaints about their treatment and had, in fact, become influential men in the community.

In the Yellow River flooded areas, which were re-settled by the Communists, the policy was to give each person an

equal area of land and to make provision for those who had not yet returned. The distribution was not done by the government or party, but by farmers' unions which were formed in each village. In other ways the policy was sound. They paid great attention to health and were building up an effective medical service by people who had only a very rudimentary, but sound, medical training. Flood control was another high priority task, also roads and communications.

There was much less evidence of police and soldiers than in south China and there was more emphasis on education, particularly for adults. At present, the government is by committees, for which they claim democratic election. Decentralisation of authority down to small units is an interesting feature in contrast to other countries.

U.N.R.R.A. as an Example of International Action

U.N.R.R.A.'s record in China must be considered in relation to the immense difficulties which had to be overcome. The civil war, the chaotic financial conditions, the tradition of corruption, were bad enough without the additional burden of the Basic Agreement. Once the supplies were received in China, there was very little could be done if they were misapplied. I believe that the programme should have been stopped when the civil war made non-political distribution of supplies an impossibility. I strongly pressed this view to my chief as early as February, 1947.

Nevertheless, U.N.R.R.A. has had a marked effect on China, and many of the projects were sound and greatly beneficial to Chinese economy. This applies particularly to flood control, importation of seed and livestock, establishment of veterinary services, and the distribution of medical equipment to hospitals. I believe that U.N.R.R.A. demonstrated something more. It proved that it is possible to recruit from all nations of the world a staff which will work loyally for an international ideal.

(*Received for publication, 27th August,* 1948.)

His Majesty's Colonial Service

There is a vacancy for a Plant Pathologist in the West African Cocoa Research Institute in the Gold Coast to undertake investigation into the diseases of Cocoa. The qualifications required are an Honours Degree in Natural Science and at least two years' post-graduate experience in Plant Pathology.

The post is permanent, and pensionable at a salary in the scale £450, £450, £450, £510 x £30—£660; £720 x £40—£1,000. In addition to basic salary a pensionable expatriation allowance is paid at following rates:—

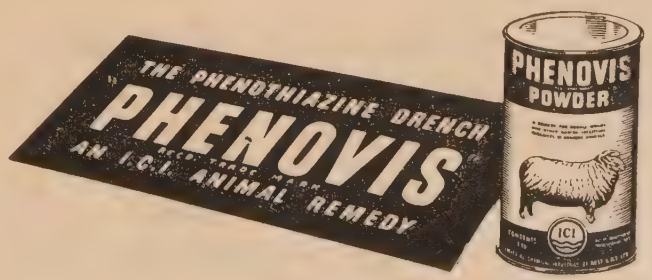
Salaries below £600—£150 per annum.
Salaries £600 to £660—£200 per annum.
Salaries £720 to £780—£250 per annum.
Salaries £840 to £1,000—£300 per annum.

Initial salary will be decided in accordance with War Service and professional experience. Income Tax is payable at local rates and free first-class passages are provided on appointment and on leave. Furnished quarters are provided at a rental of between £60 and £90 per annum.

Prospective applicants should write to Professor Wadham at the University of Melbourne.

Phenovis" Worm Remedy

When you need positive protection against costly gastro-intestinal worm parasites you need "Phenovis" — the effective phenothiazine worm remedy. Based on phenothiazine, the best and most effective known drench for nodule, large stomach and black scour in sheep, "Phenovis" also controls gastro-intestinal parasites in other stock. Supplied in handy powder form, "Phenovis" is non-toxic to sheep when used as directed and forms a highly effective drenching solution when mixed with water

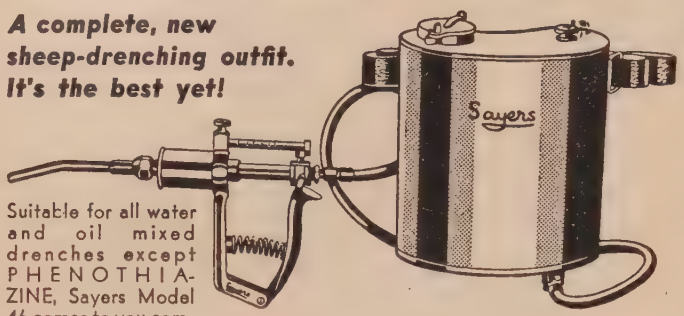


VIC. DISTRIBUTORS: GRAZCOS AND WILCOX MOFFLIN LTD.

H1-24

AUTOMATIC . . . . FASTER . . . . EASIER TO USE

A complete, new sheep-drenching outfit. It's the best yet!



Suitable for all water and oil mixed drenches except PHENOTHIAZINE, Sayers Model 46 comes to you complete with special reservoir, belt and a spare set of all valves, valve seats and springs. Dose range adjustable from 5 c.c. to 1 oz.

Sayers 1 oz. AUTOMATIC

DRENCHING GUN, Model 46, £6/8/6 complete

Obtainable from chemists and storekeepers

SPEEDIER DRENCHING

Latest in the line of sheep drenching guns, Sayers' 1 oz. Automatic Outfit, described at left, is typical of the improved, precision instruments offered by Sayers Allport Pty. Ltd. For particulars about drench guns, etc., apply to S.A.P. RURAL SERVICE, 53 Macquarie Street, Sydney.

SAYERS ALLPORT PTY. LTD.

PRECISION GLASS INSTRUMENT CO.

OFFERS THE AGRICULTURALIST

Scientific and Agricultural Glassware such as Milk Testing Apparatus, Milk-Pipettes, Babcock Flasks, etc.

Quotations for Special Apparatus Promptly Attended to

HURRY PLACE (off Charles St.), **PRAHRAN, S.1. - Phone: LA 3674**

CABLES AND TELEGRAMS "BLOWNGLASSWARE" MELBOURNE

TECHNICAL PAPERS

CAROTENE LOSSES IN CURING AND STORING CEREAL HAY

By E. J. UNDERWOOD, R. G. COLEMAN and D. H. CURNOW

Underwood and Millington[9] have shown that, under the climatic conditions typical of the Western Australian wheat-belt during the hay curing period, i.e., high day temperatures and no appreciable falls of rain, losses of dry matter and the major chemical constituents are negligible during the curing of cereal hay in the stook. Even hay cured for as long as four months in the field was found to differ little in ordinary chemical composition from the dry matter of the hay at the time of cutting. This is in marked contrast to the large losses which occur in making meadow hay under European conditions.[1, 11]

No carotene figures were presented in the paper of Underwood and Millington (*loc. cit.*) although these were obtained for the curing experiment with oaten hay but not with wheaten hay. These figures are presented in the present paper, together with the results of an experiment with wheaten hay designed to measure stack storage losses.

Experimental

The oaten hay curing experiment was carried out with the variety "Mulga" at the Merredin Research Station in 1944. The experimental design and method of sampling has been described in the paper just cited. The carotene determinations were carried out on the green material at the time of cutting and on the cured hay at the end of each curing period within 24 hours of sampling in each case.

The stack losses experiment was also carried out at the Merredin Research Station. A weed-free area of wheat (variety "Charter") was cut with a binder at the "optimum" time for hay cutting on 17/10/45 and 18/10/45 and stooked in the normal way. Five weeks later, on 22/11/45, the cured hay was carted and built into an ordinary rectangular stack. When the stack was about three feet high, sheaves were selected from the middle of the remaining stooks and two placed in each of forty-eight numbered, tared chaff bags. The bags were then weighed and placed in rows so that they were well distributed over the area of the stack. Building of the stack was then completed with the rest of the hay.

The stack was left untouched until 11/4/47 when it began to be broken down for chaffing and feeding. Further portions of the stack were broken down on 28/1/48 and 1/3/48, and it was finally used up on 13/4/48. On each of these occasions bags were exposed and immediately weighed and chaffed separately. Representative kilogram samples of each bag exposed at each time of chaffing were despatched to the Institute of Agriculture, Nedlands, for immediate analysis.

Method of Analysis

The method of Peterson[4] was used.

E. J. UNDERWOOD, B.Sc., Ph.D., is Professor of Agriculture and Director Institute of Agriculture, University of Western Australia. D. H. CURNOW, B.Sc. (Hons.), is a Biochemist in the Department of Agriculture, Western Australia, and R. S. COLEMAN is a Technical Officer in the Institute of Agriculture, University of Western Australia.

Fig. 1

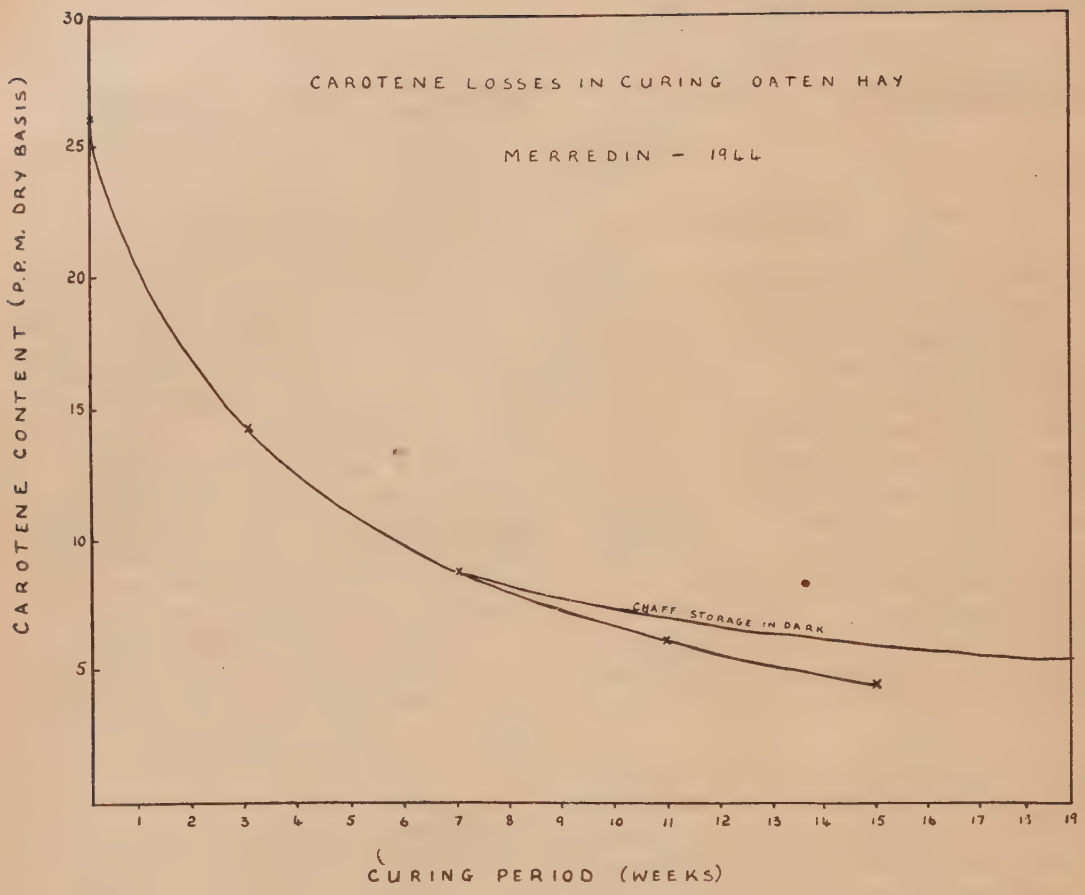

CAROTENE LOSSES IN CURING OATEN HAY
MERREDIN - 1944
CAROTENE CONTENT (P.P.M. DRY BASIS)
CHAFF STORAGE IN DARK
CURING PERIOD (WEEKS)

TABLE 1

Carotene Content of Oaten Hay under Different Conditions of Curing.
p.p.m. on dry basis.

Treatment	As cut	Cured 3 weeks	Cured 7 weeks	Cured 11 weeks	Cured 15 weeks
No. of Samples	24	6	6	6	6
Mean Carotene Content	26.5±.42	14.3±.60	8.8±.56	6.4±.30	4.6±.25
Percentage Fall in Carotene Content	—	44.4	66.8	75.8	82.6

Results

The mean carotene contents of the oaten hay from the curing experiment are presented in *Table* 1 and also in graphical form in *Fig.* 1.

The rapid deterioration in the carotene content of the hay during the early part of the curing period, and the steady fall at a reduced rate thereafter, is apparent from the table and is shown very clearly in the graph. The graph shows also that appreciable destruction of carotene occurs, even under conditions of storage in the dark, although not to the same extent as in the stook. Evidence for this is provided by the hay cured for seven weeks in the stook and then chaffed and stored in paper bags in a dark cupboard for a further twelve weeks, i.e., until nineteen weeks after cutting. At this time it was found to contain 5.8 p.p.m. of carotene which was slightly lower than the hay cured eleven weeks in the stook but considerably higher than the hay cured similarly for fifteen weeks.

The mean carotene contents of the wheaten hay from the stack storage experiment are presented in *Table* 2.

It is evident from the figures in *Table* 2 that very extensive destruction of carotene, amounting to almost 90 per cent. of that originally present in the cured hay, has occurred during the lengthy storage period. The small differences in mean carotene content between the samples stored 17, 26, 27 and 29 months respectively are not significant, suggesting that most of the destruction has occurred in the early months of storage and indicating that, after the initial extensive destruction, losses in carotene are relatively small.

Discussion

The stability of carotene in green plant materials during curing and storage has been studied fairly extensively abroad, although prior to the present investigations, no such studies with cereal hays cured and stored under Australian conditions appear to have been made.

Overseas workers agree that with green plant material there is a large initial loss in carotene following cutting and the bulk of the evidence supports the hypothesis that this large loss is due largely, but not entirely, to the action of an enzyme, probably carotene oxidase. Following enzyme inactivation due to dehydration or other causes, there occurs a slow, spontaneous oxidation of carotene

TABLE 2

Carotene Content of Wheaten Hay during Stack Storage.
p.p.m. on dry basis.

Treatment	At time of Stacking	Stored 17 Months	Stored 26 Months	Stored 27 Months	Stored 29 Months
Sampling Dates	22/11/45	11/4/47	28/1/48	1/3/48	13/4/48
Bag Numbers	1–48*	40–48	19–39	10–18	1–9
Mean Carotene Content	11.4	1.2	1.4	1.6	1.2

*Single composite sample, made up from small sub-samples from each sheaf in each of the 48 bags.

which is greatly accelerated by heat and light, but which proceeds under all ordinary conditions of curing and storage, even in the dark. For both these processes atmospheric oxygen is essential. This means that, to prevent carotene destruction, the materials must be dried and stored in the absence of air or at sufficiently low temperatures to inhibit the chemical processes involved.[3, 6, 12] Neither of these are, of course, practical possibilities for farm feeds such as cereal hays.

The climatic conditions which generally prevail during the curing period in the Western Australian wheatbelt are, as Underwood and Millington (*loc cit.*) have shown, extremely favourable to rapid curing and result in negligible losses of the principal nutrients of the hay. They are, however, not nearly so favourable from the point of view of carotene retention. The rapid dehydration which occurs under these conditions has not prevented a large enzymic destruction of carotene, as is shown by the figures of *Table* 1, while the hot, sunny days which follow have been favourable to carotene oxidation. In the same way, during storage in the stack, the relatively high temperatures which occur for many months in the year in these areas favour carotene destruction. Under American conditions Wiseman, Kane and Cary[13] and Fraps and Kemmerer[2] have shown that dried alfalfa loses carotene more rapidly in the summer than in the winter.

It is obvious that very large losses of carotene are inevitable in curing and storing cereal hay under wheatbelt conditions and it is almost certain that similar large losses would occur wherever cereal hay is made, since cooler and moister conditions during curing would lengthen the period over which enzymic destruction would take place. Once the hay is cut there is little the farmer can do to reduce carotene losses, except to shorten the period of curing to the minimum and to feed it as soon as possible after stacking. This latter procedure may be neither possible nor desirable from the point of view of maintaining fodder reserves and of carrying out a proper supplementary feeding programme on the farm.

One factor, however, which can be of considerable importance in determining the carotene content of cereal hay is the time of cutting, i.e., the stage of maturity at which the crop is cut. With similar periods of curing, earlier cutting results in hay of higher carotene content. Thus the authors (unpublished data) found the carotene content of wheaten hay cut at the *full bloom* stage to be 49 p.p.m. on the dry basis at the time of cutting and 17 p.p.m. after about a month's curing in the stook. The corresponding figures for the same crop cut at the *early dough* stage were 17 and 5.3 p.p.m. and at the *almost mature* stage 7 and 1.8 p.p.m. These differences provide at least a partial explanation of the wide range of values obtained for the carotene content of a series of "commercial" wheaten and oaten chaff samples by Underwood and Curnow[8] and emphasise the importance of early cutting of hay where quality, as distinct from quantity, is the main desideratum. This has been stressed previously in relation to the much higher digestible protein content of early cut hay.[10]

Nevertheless, it must be pointed out that there are many practical advantages in being able to spread the fodder conservation programme over a number of weeks. Delaying hay cutting to maturity, which is possible with modern machinery such as the pickup baler with cutter-bar, results in a relatively small reduction in yield of total dry matter or total digestible nutrients. Underwood and Millington (*loc. cit.*). The seriousness of the large reduction in yield of digestible protein and of carotene which would result from such a practice would depend upon the conditions under which the hay is

fed. As far as carotene is concerned it is doubtful if this would be of great significance at least for feeding to sheep, since the reserves of Vitamin A in the livers of sheep at the end of the "green-feed" period of the year are apparently sufficiently high to prevent deficiency symptoms appearing during summers of normal length.[5, 7]

Summary

Experiments were carried out at the Merredin Research Station with oaten hay to determine carotene losses during curing for varying periods in the stook and with wheaten hay to determine carotene losses during prolonged stack storage.

In the curing experiment the mean carotene content of the dry matter of the hay as cut was 26.5 p.p.m. The corresponding figures for this hay cured 3, 7, 11 and 15 weeks were 14.3, 8.8, 6.4 and 4.6 p.p.m. respectively.

In the stack storage experiment the mean carotene content of the dry matter of the hay at the time of stacking was 11.4 p.p.m. The corresponding figures for this hay stored 17, 26, 27 and 29 months were 1.2, 1.4, 1.6 and 1.2 p.p.m. respectively.

The significance of these very large losses of carotene during both curing and storage are discussed in relation to the factors known to influence carotene destruction, to the stage of maturity at which the hay is cut and to the nutritive value of cereal hay.

Acknowledgments

Grateful acknowledgment is made to Mr. E. Langfield and Mr. F. Gishuble for their able assistance with the field work, to Mr. A. J. Millington for help in the design of the experiments and to Mr. I. Thomas, Superintendent of Wheat Farming, W.A. Department of Agriculture, for making the facilities of the Merredin Research Station available.

References

1. Axelsson, J., *Svenska Valbo Mosskul turforen Kvartal skr.*, 4: 397, 1941 (*Nut. Abst. & Rev.* 12: 685, 1941).
2. Fraps, G. S. and Kemmerer, A. R., Texas Agric. Exp. Stn. Bull., 557, 1937.
3. Mitchell, H. L. and Hauge, S. M., *J. Biol. Chem.* 164: 543, 1946.
4. Peterson, W. J., *Indust. Engin. Chem.* (Anal. Ed.) 13: 212, 1941.
5. Pierce, A. W., *Aust. J. Exp. Biol. & Med. Sc.*, 24: 231, 1946.
6. Seshan, P. A. and Sen, K. C., *J. Agric. Sci.*, 32: 275, 1942.
7. Underwood, E. J. and Conochie, J., *Aust. Vet. J.*, 17: 202, 1941.
8. Underwood, E. J. and Curnow, D. H., *Ibid.*, 20: 248, 1944.
9. Underwood, E. J. and Millington, A. J., *J. Dept. Agric., West Aust.*, 24: 250, 1947.
10. Underwood, E. J. and Moir, R. J., *Ibid.*, 21: 41, 1944.
11. Watson, S. J., *Emp. J. Exp. Agric.*, 7: 43, 1939.
12. Waugh, R. K., Hauge, S. M. and Hilton, J. H., *J. Dairy Sci.*, 27: 585, 1944.
13. Wiseman, H. G., Kane, E. A. and Cary, C. A., *Ibid.*, 19: 466, 1936.

(*Received for publication*, 18*th October*, 1948.)

ERRATA

The title of the Technical Paper by R. D. Wilson and E. J. Waring, which appeared on Page 141 in the September issue (Vol. 14, No. 3, 1948), should read "Some Observations and Experiments Concerning the Role of Molybdenum in the Nutrition of the CAULIFLOWER Plant."

SOME RESPONSES OF LETTUCE TO THE APPLICATION OF MOLYBDENUM

By R. D. WILSON

Increases in the growth of lettuce (*Lactuca sativa* L.) in water culture as a result of adding small quantities of molybdenum compounds, have been reported by Brenchley and Warington[6] and by Warington[12], whilst Arnon[4] recorded very marked responses by lettuce in water culture when seven elements, of which molybdenum was one, were added in trace amounts. Arnon[5] later reported that molybdenum deficiency symptoms had been produced in lettuce and that the check in growth as a result of the deficiency was particularly striking.

It is here desired to present further evidence concerning responses by lettuce to molybdenum and, more particularly, to show that, in lettuce, as indicated by the evidence of Hewitt and Jones[8] for tomato, cauliflower and mustard, of Mulder[9] for tomato and barley and of Wilson and Waring[13] for cauliflower, molybdenum apparently acts as a catalyst in the reduction processes of the plant.

Following beneficial effects from the application of molybdenum materials for the control of whiptail in cauliflowers in the central coastal area of New South Wales[11], attention was directed to the possibility that crops other than cauliflower in the same area might also respond to molybdenum and preliminary experimental applications were made to a commercial crop of lettuce grown at Wetherill Park (about eighteen miles west of the centre of Sydney) on a clay loam soil on a farm on which about half the plants in a crop of cauliflowers were showing symptoms of whiptail.

In the block of lettuce (variety Imperial 615) selected for the experiment, the leaves on most of the plants were pale green rather than a healthy dark green, with a yellowing of many of the outer older leaves, when first seen by the writer on 28/6/1948. Some of the older leaves showed dead brown tissue on the margins and, in a few cases, death of the intervenal areas (*Figs.* 1 and 2). The grower considered that the size of most of the plants was also unsatisfactory, and this was evident when a comparison was made with a nearby block of lettuce of the same variety on the same farm, which was stated to have been planted about the same time. In this second block the plants were not only larger, but were of a healthy dark green colour with almost no marginal scorch and no yellowing of the older leaves. (For convenience in further description, the lettuce in which the stunted chlorotic condition was prevalent will be referred to as Block 1 and the other block as Block 2.) Almost every plant in Block 2 had formed small hearts whilst only about half of the plants in Block 1 had commenced to heart on 28/6/1948.

The grower stated that in recent years Block 2 had been cropped intensively with vegetables and that several heavy applications of farmyard manure had been made to this land in the preceding three years. Block 1 had been under pasture for at least three years, the present lettuce crop being the first vegetable crop to be planted there for some years. He further stated that, for the present crops of lettuce, both Block 1 and Block 2 had received applications of a commercial complete (N.P.K.) fertiliser known as

R. D. WILSON, M.Sc., M.Sc.Agr., is a Plant Pathologist in the Department of Agriculture, New South Wales.

Fig. 1.
Lettuce leaves showing marginal and intervenal scorch, associated with pale green leaf colour and occurring on untreated plants grown on acid soil at Wetherill Park where a molybdenum response was secured.

Photo by J. R. Rengger.

P.B.3, and which is stated to contain 3 per cent. nitrogen as sulphate of ammonia and 1.5 per cent. nitrogen as blood and bone. Block 1, however, had received about twice as much of this fertiliser as Block 2.

In addition to the unthrifty appearance of the plants in Block 1 and the presence of whiptail in cauliflowers on the same farm, another feature which suggested the possibility of molybdenum deficiency was the fact that tests with diphenylamine-sulphuric acid on the intervenal tissue of the older yellowed leaves gave strongly positive (blue) reactions, similar to those secured by Wilson and Waring[13] in the case of cauliflower leaves showing an intervenal chlorosis associated with the whiptail disease.

Methods

1. *Applications of molybdenum*

The first application of molybdenum was made in the form of a crude sodium molybdate containing thirty-five per cent.

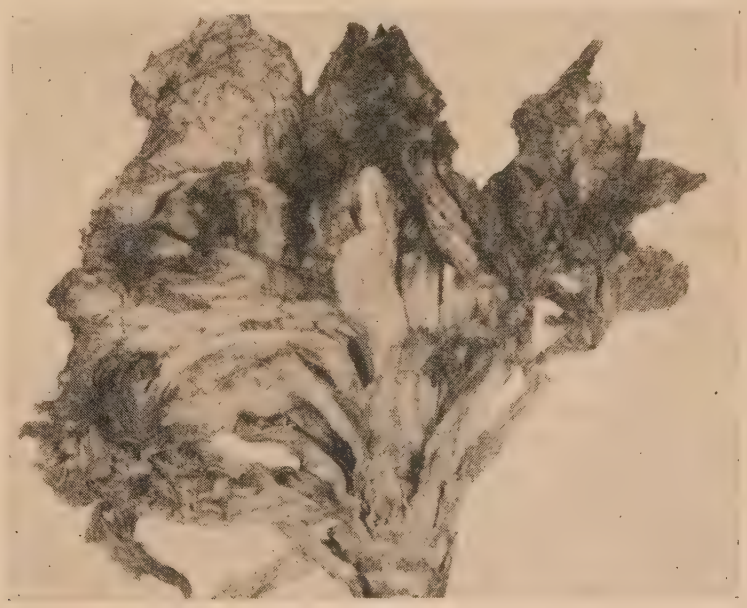


Fig. 2
Stunted lettuce plant with marginal scorch on leaves. From an untreated part of Block 1

Photo by J. R. Rengger.

TABLE 1.

Molybdenum applications.

Block No.	Bed No.	Date of application	Material used*	No. of plants treated	Rate per plant**
					grm.
	1.4	28/6/48	Sod.	59	0.07
	1.6	do.	,,	38	0.09
1	1.3	6/7/48	Am.	32	0.01
	1.5	do.	,,	34	0.05
	1.7	do.	,,	31	0.25
	1.2	15/7/48	,,	380	0.0095
2	2.2	do.	,,	96	0.0125
	2.5	do.	,,	104	0.011

*Sod. indicates crude (35%) sodium molybdate. Am. indicates A.R. grade ammonium molybdate.
**Rate per plant is average amount of pure sodium molybdate or pure ammonium molybdate per plant.

sodium molybdate. This material, which is prepared by a Newcastle (New South Wales) firm, contains a certain amount of material insoluble in water, mainly silica and alumina. The main water-soluble impurity is sodium sulphate. Subsequently A.R. grade ammonium molybdate was used.

The materials were dissolved in water and applied by watering can directly on to the middle of each plant. Tap water was used for these applications, being from the same source (Sydney water supply) as that used by the grower for watering his lettuce. The solution was applied as evenly as possible to the plants in each plot without measuring out the solution for each individual plant, and it is possible that individual plants may have received almost twice as much solution as others—the rates per plant shown in *Table* 1 are thus average rates per plant. The average amount of solution applied per plant in the various plots was between 50 and 100 mls.

Portions of six of the fifteen beds (each thirty-six yards long and one yard wide) in Block 1 were selected at random and treated with molybdenum materials as shown in *Table* 1. Portions of two of the twelve beds in Block 2 were also treated.

2. *Diphenylamine-sulphuric acid tests*

In order to determine whether the treatments had reduced the amount of nitrates or other oxidising materials in the lettuce leaves as had been observed in the case of cauliflowers[13], leaves of untreated plants and of plants previously treated with molybdenum materials were tested with a freshly prepared solution of one per cent. diphenylamine in concentrated sulphuric acid. This becomes slightly blue within a few days of preparation (apparently atmospheric oxidation) and for the detection of small amounts of oxidising material it is necessary to use freshly prepared reagent.

One leaf was taken from each of a number of plants in the treated plots and from nearby untreated plants. The plants from which the leaves were taken were selected at random but on each individual plant the leaf selected was, in

the case of plants which had hearted, either the outermost of the curled-over heart leaves or the innermost of the leaves which had not curled over. Where plants had not hearted a leaf in a "middle" position was selected. In making the tests, one 8 mm. disc was removed with a cork borer from the extremity of the main vein of the leaf so that this vein bisected the 8 mm. disc. This disc was placed in a test tube and about 2 ml. of the test reagent poured in. The tube was left undisturbed for from three to five minutes and an examination was then made to see whether there was any blue colour near the disc of tissue floating on the surface of the reagent. If no blue colour could be detected, a "nil" reaction was recorded but, if any blue colour was apparent, the tube was gently shaken to distribute the colour evenly through the reagent and the reaction graded as "very slight," "slight," "medium," or "strong." A grading of "very slight" indicated a very faint blue colour whilst "strong" represented an opaque or almost opaque solution. "Slight" and "medium" were intermediate gradings.

Because a semi-quantitative grading of this type is obviously liable to vary somewhat from time to time, a similar number (usually 10, 15 or 20) of leaves from treated plants and from nearby untreated plants in the same bed, or in the case of bed 1.2, from an adjacent bed, were tested at the same time. A few of the tests were made in the field but most were made in the laboratory on the following day, about twenty-four hours after collection of the leaves in the field.

3. *Soil pH Tests*

Soil used for the pH tests was surface soil taken at random throughout the plots. The pH was determined by means of a glass electrode.

Results

1. *Visible Responses*

Up to 15/7/1948, when the last application of molybdenum materials was made, no definite visible signs of improvement could be detected in the plants which had been treated 9 and 17 days earlier. At the next inspection on 28/7/1948 the plants treated 30 and 22 days earlier appeared to be slightly darker green in colour than untreated plants, but the difference, if any, was very slight.

In a further examination on 10/8/1948, however, all treated plants in Block 1 (treated 43, 35 and 26 days earlier) were showing an improvement in growth compared with untreated plants. The treated plants were darker in colour and appeared to be uniformly larger in size.

The lowest rate appeared to have been as effective as any of the higher rates in improving the growth of the plants, but no toxic effect was evident on the plants treated at the highest rate. A further examination was made on 24/8/1948, by which time some of the heads had been cut for market. The differences between treated and untreated portions of the beds in Block 1 were more outstanding than they had been two weeks earlier. There was again no definite difference between the various rates of treatment. The plots treated on 28/6/1948 with crude sodium molybdate did, however, appear slightly superior to those treated later with ammonium molybdate.

No differences could be detected between the treated and untreated portions of Block 2 either at this or the two earlier inspections.

2. *Tests with diphenylamine-sulphuric acid*

On 7/7/1948 tests were made on thirty leaves collected at random on 6/7/1948 from beds 1.4 and 1.6 which had been treated eight days earlier and on twenty-eight leaves from untreated plants in the same beds. Twenty-nine of the thirty leaves from treated plants gave a "nil" reaction and one leaf a "very slight" reaction (trace of blue only). Of the twenty-eight leaves from untreated

plants eight gave a "nil" reaction and twenty a positive reaction ranging from "very slight" to "strong."

Further tests were made either in the field or in the laboratory about twenty-four hours after collection of the leaves on 15/7/1948, 28/7/1948 and 10/8/1948. Results of these tests are summarised in *Table* 2. Five pairs of sets of leaves (from treated and untreated plants) were tested on the first occasion and six pairs in the case of leaves collected on the last two dates from Block 1. In every one of these seventeen series, the tests on untreated leaves gave a considerably greater number of "slight" to "strong" reactions and a considerably lesser number of "nil" reactions. It is noteworthy that of the total two hundred and seventeen tests on leaves from untreated plants in Block 1, one hundred and forty-three gave more than a very slight reaction whilst only six of the two hundred and seventeen tests on leaves from treated plants did so. Eighty-nine (41 per cent.) of the leaves from untreated plants gave a "medium" or "strong" reaction, whilst none of the leaves from treated plants did.

There was no apparent difference between the various rates of treatment with sodium molybdate or ammonium molybdate in their effect on the disappearance of nitrates or other oxidising materials. In the case of tests on leaves from Block 2, the differences between leaves from treated and untreated plants, as shown in *Table* 2, were much less than in the tests on leaves from Block 1.

3. *pH tests of soil*

Eight random samples of soil in Block 1 collected on 28/7/1948 gave pH readings ranging from 4.64 to 5.30 with most of the readings close to 5.1. In Block 2, 5 soil samples collected on the same date gave readings from 5.36 to 5.64, with an average of about 5.5.

Discussion

The visible responses secured in this experiment at Wetherill Park would sug-

TABLE 2.

Tests on leaves with diphenylamine-sulphuric acid.

Block No.	Dates of		Molybdenum treatment	No. of tests recorded as				
	Collection	Testing		Nil	V.sl.	Sl.	Med.	Str.
1	15/7/48	15/7/48 & 16/7/48	Treated	73	18	—	—	—
			Untreated	7	13	12	23	32
	28/7/48	29/7/48	Treated	55	8	3	—	—
			Untreated	8	17	22	15	8
	10/8/48	11/8/48	Treated	16	41	3	—	—
			Untreated	5	24	20	11	—
	Totals Block 1		Treated	144	67	6	—	—
			Untreated	20	54	54	49	40
2	28/7/48	29/7/48	Treated	14	5	1	—	—
			Untreated	7	7	3	3	—
	10/8/48	11/8/48	Treated	6	17	17	—	—
			Untreated	3	19	10	8	—
	Totals Block 2		Treated	20	22	18	—	—
			Untreated	10	26	13	11	—

gest that some of the other cases of leaf yellowing and stunting which, from time to time, have been observed on acid soils in the central coastal areas of New South Wales would have responded to the application of molybdenum materials. For example, the case reported[3] from Hawkesbury Agricultural College in 1939 where improved growth of lettuce was secured from the application of dolomite and lime to the soil before planting, was possibly a case of molybdenum deficiency. There is now considerable evidence, most of which is summarised by Anderson and Oertel[2], to support the fact that molybdenum availability increases as the soil becomes less acid and that one of the beneficial results from the use of lime or dolomite, as in the case of the whiptail disease of cauliflowers[7, 11] and nitrogen fixation by legume root nodule bacteria[2], may be to make the molybdenum in the soil more available. The better growth of the lettuce in Block 2, and the absence of any visible response to molybdenum applications in this block are correlated with a somewhat higher pH of the soil in this block compared with Block 1. Other factors such as previous cropping and fertilising and also the higher application of fertiliser said to have been made to Block 1 may have been responsible rather than the difference in soil pH. Further work is required to determine whether, on acid soils such as that of Block 1 in the experiment at Wetherill Park, where available molybdenum was apparently insufficient for optimum growth of lettuce, the deficiency can be remedied better by changing the soil reaction with lime or dolomite or by applying molybdenum materials. It is not unlikely that the responses would have been more marked in Block 1 had the molybdenum applications been made at planting or shortly afterwards. The slight differences in the chemical tests on treated and untreated leaves in Block 2, though not conclusive, do suggest that here also the molybdenum was affecting the physiology of the plants and that even here an earlier application of molybdenum may have produced a perceptible difference in growth.

The fact that, both in visible responses and chemical tests in Block 1, the lowest rate (0.0095 grams of ammonium molybdate per plant or about one pound per acre) was not significantly different from the higher rates, would suggest that this lowest rate was more than actually required.

It would appear that the molybdenum applications definitely resulted in a reduction in the amount of nitrates and other oxidising materials in the leaves in the case of Block 1 lettuce. Three criticism, however, might be made of this contention. One is that, in spite of random selection of the portions of the beds to which the molybdenum materials were applied, there may have been some unconscious selection of better portions of the beds. In this respect records of diphenylamine-sulphuric acid tests on the same plants before and after treatment would have been of value. Another is the fact that only one portion of the leaf was tested in each case—namely the extremity of the main vein, and that only certain leaves in a "middle" position were used. Finally, there is the possibility that the molybdenum taken up by the plant might in some way directly interfere with the oxidation of the diphenylamine to diphenylbenzidine violet. However, molybdates themselves give a blue colour with the reagent when tested in the laboratory, and the only logical explanation of the effects noted appears to the writer to be that the molybdenum was acting as a catalyst in the reduction processes of the plant.

The results are in agreement with those reported by Steinberg[10] and Mulder[9] in the case of the fungus *Aspergillus niger* and for various green plants by Hewitt and Jones[8], Mulder[9] and Wilson and Waring[13]. They are also in general agreement with the findings in the case

of both symbiotic and non-symbiotic nitrogen-fixing bacteria, where it has been demonstrated that a deficiency of molybdenum decreases the efficiency of these bacteria in the reduction of nitrogen to ammonium compounds. The latest published work on this aspect seen by the writer is that of Mulder[9] who also showed that molybdenum was essential for denitrifying bacteria. Thus the evidence so far available indicates that the role of molybdenum in plants is that of a reduction catalyst concerned especially with nitrogen nutrition. Whether the element functions in any other role in plant nutrition has yet to be shown. Although all the field responses to molybdenum so far secured with pasture legumes, as stated by Anderson[1], appear to be due to the correction of a nitrogen deficiency, whilst, in the case of whiptail of cauliflower and the stunting and leaf yellowing of lettuce reported in this paper, the molybdenum deficiency is associated with abundant nitrogen, the fundamental effect of molybdenum as a reduction catalyst is apparently the same in all cases.

The results shown in *Table* 2 suggest that, towards the end of the experiment, the content of oxidising material in the leaves of untreated plants in Block 1 decreased whilst that of leaves of treated plants in the same block increased. The figures obtained are suggestive only and further work would be necessary to confirm this. There is also evidence that the leaves of treated plants in Block 2 had a higher content of oxidising material than leaves of comparable treated plants in Block 1. This would suggest that, where the molybdenum content of the leaves was already adequate or almost adequate for the plant's requirements, the application of molybdenum materials did not greatly decrease the amount of oxidising material in such leaves, whereas where leaves had an inadequate molybdenum content, the application of molybdenum caused a sudden reduction in the amount of oxidising material present.

The results are not quite as clear cut and convincing as those obtained by the writer and E. J. Waring[13] in earlier experiments with cauliflowers, but in the case of cauliflowers the occurrence of the intervenal chlorosis symptoms enabled experiments to be conducted on plants which were obviously diseased.

Summary

1. A leaf yellowing and stunting of lettuce, accompanied by a marginal scorch of the outer leaves and associated with high content of oxidising materials in the intervenal tissue of the older yellowed leaves, is described in the case of a crop grown on acid soil (pH about 5.1) at Wetherill Park, N.S.W.

2. Applications to such lettuce of sodium molybdate and ammonium molybdate at rates of 0.07 and 0.09 grams per plant, in the case of the former material, and at rates ranging from 0.0095 to 0.25 grams per plant in the case of the latter material, resulted in better growth and a darker green colour, compared with untreated plants, within twenty-six to forty-three days.

3. Tests with one per cent. diphenylamine in concentrated sulphuric acid on leaves of treated and untreated plants showing symptoms of leaf yellowing and stunting indicated that the application of molybdenum materials had resulted in a reduction in the amount of oxidising materials. Convincing results from these chemical tests were secured within thirteen to thirty days before definite visible responses were noted.

4. Similar chemical tests on leaves of plants making apparently healthy growth indicated that the molybdenum treatments had apparently not caused a reduction in the amount of oxidising materials to the extent

You can be SURE of

BLUE RIBBON *Seeds*

The seeds with the analysis of purity and germination stated at time of sale. See your nearest Blue Ribbon Seed Distributor. If you cannot locate him, write to—

WRIGHT, STEPHENSON & CO. (Aust.) PTY. LTD.,

34 QUEEN STREET, MELBOURNE and at SHEPPARTON

PLANT PROTECTION PRODUCTS

We wish to advise that we can supply a complete range of Insecticides, Fungicides, Weedkillers, and sundry products for the man on the land.

D.D.T. and "Gammexane" Gamma B.H.C. } *Prepared Dusts, Dispersible Powders, Emulsions and Pastes*

DERRIS *Dusts and Sprays*

OILS *White Oil, Tar Oils, D.N.O.C. Oil*

COPPERS *Prepared Copper Fungicides, Copper Oxychloride*

SULPHURS *Wettable Sulphurs, Dispersible Sulphur of extreme fineness*

WEEDKILLERS *Methoxone, Sodium Arsenite, etc.*

ALSO—Lead Arsenate, Wormkiller, Tartar Emetic, Hortomone, Shirlans, H.E.T.P., Agrals, etc.

Pamphlets and full particulars posted free on request

WILLIAM COOPER & NEPHEWS (Australia) PTY. LIMITED

Cooper House
9 O'Connell Street, Sydney.

GREATER PROFITS

FOR MARKET GARDENERS & ORCHARDISTS

★ *Reduces Dusting Expenses*
★ *Eradicates Insect Pests*
★ *Saves Crop Wastage*

South and Western Australia's best-known market gardeners say "there is nothing to equal David Gray's D.D.T. Agricultural Dust for eradicating insect pests, saving crop wastage, and reducing dusting expenses." And they're right. Not only does David Gray's D.D.T. Agricultural Dust kill quickly the garden insect pests on the crop at the time of dusting, but it remains effective for SEVERAL WEEKS, as rain or watering will not wash off the D.D.T. residue. Try it on YOUR crops and watch your profits increase.

David Gray's

D.D.T.

AGRICULTURAL DUST

OBTAINABLE FROM

WOODELL AGENCIES LTD., 578 Bourke Street West, Melbourne, C.1., Vic. M 1271-2.
WOODELL AGENCIES LTD., 142 North Terrace, Adelaide, S.A. C 6733.
DAVID GRAY & CO. PTY. LTD., 2-10 Railway Parade, West Perth, W.A. B.A. 2266-7.

And all leading Wholesale Market Gardeners in these three States.

which they did in the case of the unthrifty plants.

5. Neither visible responses nor chemical tests indicated that the higher rates of application were more effective than the lowest applied (0.0095 grams of ammonium molybdate per plant). This lowest rate may have been more than required to completely correct the deficiency. No toxic effects were observed as a result of the highest rate of application (0.25 grams of ammonium molybdate per plant).

6. It is considered that the results not only demonstrate a field response to molybdenum by lettuce but also that, in the case of this plant, one function of molybdenum is that of a reduction catalyst.

References

1. Anderson, A. J., *J. Aust. Inst. Agric. Sci.*, **14**: 28-33, 1948.
2. —— and Oertel, A. C., *Coun. Sci. Ind. Res. (Aust.) Bull.*, 198, Pt. 2, 1946.
3. Anon., *Agr. Gaz., N.S.W.*, **50**: 490-492, 1939.
4. Arnon, D. I., *Amer. J. Bot.*, **25**: 322-325, 1938.
5. —— *Chron. Bot.*, **6**: 56-57, 1940.
6. Brenchley, W. E. and Warington, K., *Nature*, **149**: 196, 1942.
7. Davies, E. B., *Nature*, **156**: 392-393, 1945.
8. Hewitt, E. J. and Jones, E. W., *J. Pomol. and Hort. Sci.*, **23**: 254-262, 1947.
9. Mulder, E. G., *Plant and Soil*, **1**: 94-119. 1948.
10. Steinberg, R. A., *J. Agric. Res.*, **55**: 891-902, 1937.
11. Waring, E. J., Shirlow, N. S., and Wilson, R. D., *J. Aust. Inst. Agric. Sci.*, **13**: 187-188, 1947.
12. Warington, K., *Ann. Appl. Biol.*, **33**: 249-254, 1946.
13. Wilson, R. D. and Waring, E. J., *J. Aust. Inst. Agric. Sci.*, **14**: 141-145, 1948.

(Received for publication, 30th August, 1948.)

COMMONWEALTH AGRICULTURAL BUREAUX

RECENT TECHNICAL COMMUNICATIONS

Arrangements have now been made to import bulk supplies of the most recent C.A.B. Technical Communications and to make them available for purchase from the C.A.B. Liaison Officer, C.S.I.R. Information Service, 314 Albert Street, East Melbourne, C.2, for the Australian equivalent of sterling prices. The following are now available or in shipment from the United Kingdom:—

"List of Research Workers, Agriculture and Forestry, in the British Commonwealth." 1947. Price: 9/5.

Bureau of Pastures and Field Crops Bulletin 39. "Five Hundred Varieties of Herbage and Fodder Plants." 1948. Price: 18/9.

Bureau of Plant Breeding and Genetics, Technical Communication No. 14. "Technique of Breeding for Drought Resistance in Crops." 1948. Price: 3/2.

C.A.B. Joint Publication No. 12. "Phenothiazine 1942-46. A Review and Bibliography." 1947. Price: 5/-.

Bureau of Pastures and Field Crops Bulletin 36. "The Grasslands of Latin America." 1948. Price: 25/-.

Bureau of Horticulture and Plantation Crops, Technical Communication No. 19. "Seed Production of European Vegetables in the Tropics." 1948. Price: 2/6.

Bureau of Soil Science, Technical Communication No. 44. "The Spectrographic Analysis of Soils, Plants and Related Materials." 1948. Price: 15/8.

CERTIFIED SEEDS

Endorsed by Depts. of Agriculture!

The wide range of certified seeds now available to growers carries the guarantees of the Depts. of Agriculture. Reliability, dependability, and PROVED Strain, Purity and Germination.

These certified varieties include:

RYE GRASSES—Victorian Govt. Certified PERENNIAL. N.Z. Govt. Certified PERENNIAL "Mother." N.Z. Govt. Certified PERENNIAL "Permanent Pasture." N.Z. Govt. Certified Short Rotation "H.1." N.Z. Govt. Certified "Mother;" Italian.

COCKSFOOT — New Zealand grown, N.Z. Government Certified.

CLOVERS—Red Mammoth Broad, Certified. White, N.Z. Govt. Certified "Mother." White, N.Z. Govt. Certified "Permanent Pasture." White, Dingee Irrigation, Vict. Govt. Certified. Strawberry "Palestine" Certified.

SUBTERRANEAN CLOVERS — Subterranean, Mt. Barker, Mid-season flowering strain, Vict. Govt. Certified. Subterranean, Tallarook, late flowering strain, Vict. Govt. Certified. Subterranean, Bacchus Marsh, early flowering strain, Vict. Govt. Certified. Subterranean, Dwalganup, first early flowering strain, Vict. Govt. Certified.

PHALARIS—Tuberosa, Vict. Govt. Certified.

Prompt Despatch Guaranteed
Prices Net on Rails Melbourne
Net Weight Seeds Supplied

G&N SEEDS

Gippsland & Northern Co-op. Co. Ltd.

(Reg. Office) Seed Dept: 492-4 Flinders Lane, Melbourne. Telephone: MU 8141 (10 lines). Telegrams: "Gippsnorth" Seed Dept., Melb.

"Seeds for Sowing"

REVIEWS

HORMONES AND HORTICULTURE.

The Use of Special Chemicals in the Control of Plant Growth

By G. S. Avery, Jr., E. B. Johnson, R. M. Addoms and B. F. Thomson.

(*McGraw Hill Book Company, Inc., New York and London*, 1947, *pp.* 317. *Price* $4.50.)

This is an up-to-the-minute book on a subject of great topical interest to horticulturists.

The authors interpret the use of hormones as a "real chemical revolution in agricultural practice," and that "with the current efforts to regulate growth by the application of minute amounts of growth-controlling hormones, we enter an important new era. . . . For the first time, man can change the pattern of growth and development of plants, can retard growth here or speed it there. The growth-controlling hormones and other chemicals now in use are but crude beginnings."

The authors point out that not one of their number is primarily a horticulturist, but that a number of years of theoretical research and general interest in the hormone field on the part of the senior author have led them, as a group, to carry out the arduous task of assembling, and digesting, the practical advances that have sprung from scientific work. "Our purpose," they say, "has been to gather together the widely scattered and often theoretical information on the use of special chemicals in the regulation of plant growth; to present specific directions for applying such chemicals; to evaluate their usefulness in horticultural practice; and to point out trends in the field. The various chapters of the book have had the criticism of horticulturists who are specialists on the subjects concerned."

The contents at once display the wide and practically important uses of hormones in horticulture. Ten main uses are grouped and discussed:—

Rooting of cuttings.

Blossom-thinning sprays in the control of fruit production.

Control of the pre-harvest drop of fruits.

Hormones as aids to fruit set and to seedless fruit production.

Treatment of seeds.

Hormones and vitamins in relation to miscellaneous growth phenomena.

Weed control.

Breaking dormancy.

Prolonging or inducing dormancy.

Chemical production of new varieties.

Each chapter is well documented. The whole work is well illustrated, and the practical information on the use of hormones as applying to a great variety of plants is extensive and well condensed. For instance, the table giving the improved rooting of cuttings from hormone treatment deals with an extraordinary number of species and occupies 70 pages, whilst that on the hormone treatment of seed occupies 12 pages. By such condensations the authors have produced a valuable reference book within the compass of some 300 pages.

An advantage to both the practitioner and the investigator is that the merits and demerits of substances other than hormones that have been used in particular instances are discussed. Altogether, the book is indispensable reading to all interested, practically or theoretically, in any of the ten grouped applications of hormones to horticulture.

In line with all volumes in the McGraw Hill Publications in the Botanical Sciences, the book closes with an ample index.

F. T. BOWMAN.

THE SOIL AND PLANT.

By E. Vanstone.

(*MacMillan & Co., Lond.* 1947, *pp.* 71. *Price* 4/6 *sterling.*)

Practical methods of farming have reached a high degree of perfection, and the greatest need of the farmer is a more thorough grasp of the natural laws underlying his practice. This volume provides the farmer with a simple account of the soil in special relation to the plant which will furnish him with reasons for the various agricultural practices related to his soil.

The book should be of value also to teachers and students of Agricultural Chemistry. The author is widely experienced in the teaching of soil chemistry and the book consists mainly of lectures given to students taking diploma courses at the Seale Hayne Agricultural College. It should be welcomed by students of Agricultural Science at the leaving standard in high schools and students in agricultural colleges.

The subject matter is excellently arranged in 14 short chapters. The first is written to assist the farmer or gardener in an understanding of the basic principles of agricultural chemistry, the second and third consider soil formation and the fineness of soil particles. The requirements of plants are covered in six further chapters and there are additional chapters on soil acidity, soil analysis and soil classification. In a general conclusion farmers are challenged to make better use of scientific discovery.

C. E. HAINES.

FERTILIZERS AND MANURES

By E. Vanstone.

(*MacMillan & Co., Lond.*, 1947, *pp.* 77. *Price* 4/6 *sterling.*)

This volume is a sequel to "The Soil and the Plant."

The aim of the author is to give readers a clear and concise account of the methods of manufacture, essential composition and properties of the various fertilizers and the effects of each on the soil and the plant.

The book should be of interest to a wide circle of readers, including those concerned with the industrial side of fertilizer manufacture as well as farmers, gardeners and students. It is a clear and up-to-date account of the nature of those substances used to assist the growth of plants.

There are 17 short chapters, nine of which are devoted to the common chemical fertilizers and organic manures, including one on the manufacture of composts which should be appreciated by gardeners. The controversy between "natural" and "artificial" fertilizers is discussed in a chapter in which the claims of the opponents of chemical fertilizers are refuted. There are additional chapters on the preparation of compound fertilizers and principles of fertilization of horticultural and agricultural crops. The final chapter on experimental methods of determining the relative efficiency of fertilizers has been included to assist the farmer in the study of information obtained from actual field trials.

C. E. HAINES.

THE USE OF AUXINS IN THE ROOTING OF WOODY CUTTINGS

By Kenneth V. Thimann and Jane Behnke

(*The Harvard Forest, Petersham, Massachusetts*, 1947, *pp.* 272, *with* 2 *tables. Price* $1.00.)

The work under review will be most welcome, since it provides a summary of information concerning the use of auxins in promoting root formation—one of the most widespread and useful practical applications of the study of plant hormones.

An introduction of only 8 pages of text is devoted to a brief statement of principles, explanations concerning the use of the tables and a key to the abbreviations used. There is also a useful list of the more frequently encountered proprietary preparations, with details of their compositions where these are known. The remainder of the book consists of 2 extensive tables which summarise the data available from the literature on the subject.

L. A. T. BALLARD.

PRINCIPLES OF FOOD FREEZING.

By Willis A. Gortner, Frederick S. Erdman and Nancy K. Masterman.

(*John Wiley and Sons, New York; Chapman and Hall Ltd., London,* 1948, *pp.* 281. *Price* $3,75.)

Representing the collaborative effort of three members of the School of Nutrition, Cornell University, this recently published book is one of the best contributions to the literature dealing with the general subject of freezing preservation.

As the title suggests, the book is concerned with the scientific principles involved in the selection of raw material, processing and freezing of food, rather than a detailed statement of directions and procedures. It is a technical work in that "it explains the biochemical and nutritional aspects concerned in the freezing, storage and cooking processes, and deals with the engineering principles involved in the construction and operation of equipment." However, it does not pre-suppose a background on the part of the reader in any of the basic sciences.

It will, therefore, be of assistance not only to the commercial food processor, engineer and food technologist, but also to the layman who is interested in the subject of freezing from the general point of view.

The extension of freezing principles to the relatively new practice of home-freezing and the use of frozen foods in the home is treated fully by Miss Masterman, a home economist who has specialised in this field of preservation.

S. M. SYKES.

DIGESTS

NOOGOORA BURR IN RELATION TO THE WOOL INDUSTRY — and the Use of Hormone Weed Killers

By A. P. DODD

The seriousness of Noogoora Burr in the sheep country is apt to be overlooked in years of high prices but the fact remains that the losses are serious and occur every year in the affected areas. Records for the five-year period commencing 1941 show that an average of eight per cent. of the Queensland clip was affected; in one year the percentage was sixteen per cent. Assuming an average price for wool of fifteen pence per lb. and an average loss through burr of twopence per lb. on burry clips, it is apparent that the average annual loss for the period was £120,000—a property shearing 20,000 sheep would lose £1,250 per annum. On some clips it was estimated that burriness would lead to a loss of as much as eightpence per lb.

Noogoora Burr infestation has increased rapidly in the last fifteen years. The greater part of the Queensland sheep country is already infested and the remainder is seriously menaced. The only major river systems not heavily infested are Cooper's Creek, Diamantina and Hamilton-Georgina. On many properties sheep have had to be abandoned in favour of cattle. The burr appears to be spread more by travelling stock than by floods or downstream movement. The problem of control is an unusual one because a relatively small area of burr may affect the wool of all sheep over a very large stretch of country. Such control measures as pasture and grazing management, competing plants, etc., are not applicable, and the application of any treatment is limited by its cost, since sheep country is valued at under (often much under) one pound per acre. Pulling and cutting are slow methods and costly, and arsenical sprays are not favoured on account of the objections of the operators and danger to stock. Biological control has not had much success, although many surveys have been carried out overseas and a seed fly has actually been established in a few localities in this State; many stem borers are known but are not likely to be used since they also attack economic plants.

Five different hormone preparations were used in the initial experiments and it was found that all gave successful and comparable results at 0.1 per cent. dilution on all stages of growth up to eight feet. Normal sheep station equipment, i.e., a jetting power plant, was adapted for use by mounting on a truck and providing a hose to give a coverage of one hundred and ten feet radius with a double nozzle spray at a pressure of eighty pounds. A dilution of 0.05 per cent. was effective with actively growing plants, but twice this concentration is recommended for general use. The rate of application averages eighty gallons per acre, with a range of seventy-five to one hundred and thirty-two gallons, and

From an address to the Queensland Branch of the Institute on 16th July, 1948.

would cost approximately £1/15/- per acre. This is high when the rental value of the land is considered, but not exhorbitant on the basis of the value of the industry. After the first two seasons the cost should become very much less.

Bathurst Burr was found to be as sensitive to hormones as the Noogoora and, since it does not grow so densely, did not need more than fifty gallons of 0.1 per cent. solution per acre. Weir Vine (*Ipomoea calobra*), which occurs in a belt through the Maranoa district, is regarded as causing serious losses of sheep; it can be controlled with even less solution than for Bathurst Burr, at a cost of about 14/6 per acre. The long-spined thorn apple (*Datura ferox*) which is a problem in the Dalby district is unfortunately quite resistant to the hormone preparations available at the moment.

SUGAR CULTURE IN HAWAII

By J. L. CLAYTON

Despite the publicity which the Hawaiian industry has received over the year its production is only on a par with Queensland's and it has approximately the same number of mills. All cane is produced on the plantation system and consequently any new developments in agriculture can be applied very rapidly on a large scale. This has happened in the case of the chemical control of weeds in the cane fields and all plantations are now using hormone weed killers, sometimes in conjunction with, sometimes without, the concentrated, activated diesel oil emulsion (C.A.D.E.)

The methods of application and dosages are still subjects for trial and error on the plantations; there just has not been time for careful experimentation. The aeroplane shows promise as a means of applying the sprays, but in the meantime, quite complex appliances attached to tractors have been developed. Couch grass and an oxalis are weeds of the canefields which are difficult to control chemically but results against others have been so spectacular that most plantations now do not cultivate mechanically at all.

Irrigation is assuming even more importance as the growers realize that it is more economical to grow cane in the drier areas and irrigate it, than to suffer the harvesting troubles inherent in cane culture on the wet windward slopes. A semi-permanent concrete fluming with small gate valves for each furrow, is used by one plantation and others have experimented with paper flumes and overhead sprays. Irrigation in Hawaii has involved a tremendous amount of capital and some of the plants are on a large scale. One seen was sited four hundred feet underground and capable of delivering 12,000,000 gallons per day.

The fertilizing of cane crops in accord with results of analyses of parts of the growing plant has been well developed by some of the plantations and excellent returns are claimed for this method of crop control.

Harvesting of the tangled two-year-old crops is done mechanically and practically all transport to the mills is by large trucks, some taking twenty tons at a time. There is a large amount of extraneous matter brought to the mills with the cane and the cleaning of the cane necessitates an apparatus almost as complicated as the mill itself. At times one-third of all material coming to the mill consists of mud, soil, stones and other rubbish and at one particular mill one ton of this has to be removed every minute.

From an address to the Queensland Branch of the Institute on 28th July, 1948.

THE LOSS OF SOIL FERTILITY IN NEW SOUTH WALES—
As Reflected by Depleted Nitrogen Content and its Effect on the Baking Quality of Wheat

By S. C. GRAHAM

The term "wheat quality" is used in its commercial sense—that is ability to yield the maximum quantity of commercially acceptable flour with minimum expenditure of power. The miller cannot get the desired result by relying on F.A.Q. wheats, but must purchase in addition, premium wheats. The term "premium wheat," as applied in New South Wales is relatively new. Any variety of wheat which the miller assesses at a value above parity, is a premium sample. While premiums have been paid for low quality varieties, even Bencubbin, where the grain may be required for a special purpose, premiums are normally and usually paid only for varieties of high potential baking quality which are used to support low quality F.A.Q. truckings.

The marked quality deterioration in the same variety of premium class that has been apparent over the past decade, constitutes a grave problem not only to local, but also overseas, buyers of Australian wheat.

The deterioration is manifested in many cases by a condition known as "mottling" where the grain matures with a mottled appearance in contrast to the normal "clear" condition of good quality grain. Mottling in Australian grain did not appear as a commercial problem prior to about 1930 but its incidence since that date has been serious. It was observed when this condition first aroused interest, that it was invariably associated with low protein content and hence decreased baking quality in the harvested grain.

No serious investigation of the problem was undertaken during the first six or even eight years of its appearance. It was the constant correlation between "mottling" and protein content observed over a period of six years and in thousands of samples, that was responsible for a series of large-scale field experiments being initiated at Gilgandra.

The original experiment was carried out with two varieties which, at the time, were claimed to be more susceptible to mottling than others—"Dundee" and "Eureka."

In each case the variety was sown in two areas, one of which had been bare fallowed, and the other sown to oats which were fed off, allowed to develop again, and then ploughed in.

Both varieties behaved in a similar manner in their reaction to the two treatments—being mottled, of lower protein content and lower yield on the bare fallow.

In the following year the experiment was repeated with the addition of a third treatment incolving the use of a nitrogenous fertiliser, the results confirming the idea that nitrogen deficiency is closely associated with low quality and mottling.

The experiment was further expanded in the 1946 sowing, the following results indicating the apparent correlation between available nitrogen and the quality factors considered.

It still remains for final confirmation but the indications are that with depleted nitrogen conditions in our wheat areas so also is found, low protein crops, lower yields and the incidence of mottling.

From an address to the New South Wales Branch of the Institute on 27th August, 1948.

Mr. Graham stated that his remarks were based on observations of the quality level of Australian wheat—with emphasis on New South Wales—over fourteen to fifteen harvests.

TABLE 1.

Relation between seed bed treatment, protein content and appearance.

Variety	Type of Seed Bed	% Protein	Appearance
Koala	Bare fallow	8.1	mottled
Koala	Green ploughed in	10.3	clear
Gabo	Bare fallow	9.6	mottled
Gabo	Green ploughed in	11.2	clear
Yalta	Bare fallow	8.4	mottled
Yalta	Green ploughed in	12.3	clear
Charter	Bare fallow	9.0	mottled
Charter	Green ploughed in	12.3	clear
Gular	Bare fallow	9.2	mottled
Gular	Green ploughed in	11.7	clear
Bungulla	Bare fallow	10.0	clear
Bencubbin	Bare fallow	8.0	clear
Kendee	Bare fallow	8.9	mottled

Mr. Graham concluded by appealing for greater co-operation between plant breeders and millers. The miller needs quality in varieties of the Ford type, so that he has soft easy milling wheats of more generous gluten quality than hard wheats, though nitreous varieties are also required.

THIRTEENTH GENERAL MEETING

NOTICE is hereby given that the Thirteenth General Meeting of the Australian Institute of Agricultural Science will be held on Monday, 10th, and Tuesday, 11th January, 1949, in the Physics Lecture Theatre, University of Tasmania, Sandy Bay, Hobart.

AGENDA.

Monday, January 10

9.00 to 10.00 a.m.—Meeting of Council.

1st Session.

(10.15 a.m. to 12.30 p.m.)

10.15 a.m.—1. Formal Business: Credentials, Proxies, Standing Committees, etc.

10.45 a.m.—2. Opening Address—President.

11.00 a.m.—3. General Business.
(a) Minutes of 12th General Meeting (Sydney, 19th March, 1948).
(b) Report of Council on Institute Activity.
(c) Report of Editor of Journal for Volume 14.
(d) Report of Business Manager of Journal for Volume 14.
(a) Statement of Accounts.
(f) Report of Council concerning Election of President.

2nd Session.

(2.00 p.m. to 5.00 p.m.)

2.00 p.m.—4. Journal Business.
*Resolutions arising from discussion.

3.30 p.m.—5. **Alteration of Articles of Association.**

4.30 p.m.—6. Scholarship Sub-Committee.
*Resolutions arising from discussion.

Evening Session.

6.30 p.m.—Dinner at Wrest Point Hotel followed by—
(a) Presidential Address.
(b) Award of Australian Medal of Agricultural Science.

Tuesday, January 11

3rd Session.

(9.30 a.m. to 12.30 p.m.)

9.30 a.m.—7. Salaries and Status.
*Resolutions arising from discussion.

10.30 a.m.—8. Interchange of Personnel
*Resolutions arising from discussion.
A resolution is forecast from A.C.T. that Council take more effective action to have restrictions on free interchange of scientific personnel removed.

11.30 a.m.—9. Agricultural Engineering.
*Resolutions arising from discussion.
A resolution is forecast from Victoria that this Institute believes that research in Agricultural Engineering is needed in Australia in order to promote continued improvement in agricultural production; and recommends the C.S.I.R. and the Australian Agricultural Council to recognise this need officially, and to take steps to make research in this field possible.

STINTON'S

CLAREMONT PRODUCTIONS

- Shelter Trees and Shrubs
- Bedding and Herbaceous Plants
- Fruit and Ornamental Trees
- Roses, Bulbs and Seeds

FOR ALL YOUR HORTICULTURAL REQUIREMENTS CONTACT —

STINTON'S CLAREMONT NURSERIES

GEELONG — VICTORIA

TELEPHONE 5594

"Where Only The Best Are Grown"

Destroy Insect Pests

SUSPENSIBLE **GUESAROL** D.D.T. POWDERS

Active Ingredient 40 per cent. P.P. Isomer D.D.T.

MANUFACTURED BY

ORIGINATORS OF **Geigy** D.D.T. INSECTICIDES

For Easy to Wet Crops order GUESAROL FS.40 (Yellow Label)

For General Horticulture order GUESAROL GH.40 (Green Label)

For Hard to Wet Crops order GUESAROL BW.40 (Blue Label)

There is a GUESAROL spray for EVERY TYPE OF CROP

WITH THREE VITAL ADVANTAGES

1-WETTING 2-SPREADING 3-STICKING

ENSURING JUST THE RIGHT COVERAGE

Simply Mix with Cold Water!

Packed in 5lb. and 28lb. Cartons

•

Sole Distributors of Geigy GUESAROLS in Australia

WILCOX MOFFLIN LTD.

(To whom all enquiries should be directed)

15 PHILLIP STREET, SYDNEY

CONTINUOUSLY AT WORK IN SCIENTIFIC AGRICULTURE

ABO

FERTILIZERS

W. PATON & CO., MANUFACTURERS

175 Hay Street, SYDNEY, N.S.W.

4th Session.
(2.00 p.m. to 5.00 p.m.)

2.00 p.m.—10. Rural Extension Services. *Resolutions arising from discussion.

2.30 p.m.—11. Other Business.

4.00 p.m.—12. Resume of Resolutions and Recommendations. Report of Resolutions Committee.

4.45 p.m.—13. Transfer of Office of Management.

4.55 p.m.—14. Installation of Incoming President.

5.00 p.m.—End of Business Session.

Technical Papers. Technical Papers from A.I.A.S. will be presented at meetings of Section K of A.N.Z.A.A.S.

Final Council Meeting. To be arranged.

*Resolutions. Council has ruled that Resolutions arising out of discussions will be accepted provided only that Resolutions calling for an amendment to the Constitution must be submitted in conformity with Articles of Association.

COUNCIL PROCEEDINGS

A meeting of Council was held at the University Club. Sydney, on Tuesday October 5, 1948.

Present:

The Hon. General Secretary (L. F. Mandelson), the Hon. General Treasurer (F. C. McCleery), Professor J R. A. McMillan (A.C.T.), Messrs. W. Poggendorff (N.S.W.), G. de Vahl Davis (S.A.), R. H. Anderson (Tas.) and E. J. Breakwell (W.A.). Apologies were received from the President (A. F. Bell) and Messrs. J. M. Vincent (Qld.) and R. H. Hayman (Vic.).

In the absence of the President, the N. S. W. Proxy Councillor (W. Poggendorff) occupied the Chair.

Office of Management:

On the motion of the Hon. General Treasurer, seconded by Mr. G. de Vahl Davis, it was resolved that:—

"In view of the Resolution of the 7th General Meeting adopting 'the principle of rotation of the Office of Management' and of the notification from the N.S.W. Branch dated 6/7/48 that the Office of Management was in its fourth year in N.S.W., that each Principal Delegate be asked to indicate by November 1 which Branch, in his opinion, should be invited to take over the Office of Management."

Salaries and Status:

The Hon. General Secretary reported that Queensland had found the Report with last Council Minutes of use and interest. Mr. W. Poggendorff (N.S.W.) stated that his Committee agreed to adopting the C.S.I.R. scale of salaries and system of advancement as a basis of claims, but had not changed its view that little useful purpose will result in view of the present method of salary determination.

As the W.A. Branch had requested that this subject be discussed at the Hobart Meeting it was decided to ask that Branch to set up a Sub-Committee to prepare a report for submission to that Meeting.

Journal Business:

The following resolutions concerning the Journal were received:—

From the Victorian Branch—"That this Branch expresses appreciation through Council to the Editor and members of the Publications Committee on the excellence of the Journal produced by the new Committee."

From the A.C.T. Branch—"That this Committee requests Council to formulate a policy for guidance of the Publications Committee of the Journal of the

Australian Institute of Agricultural Science, with particular regard to improving the standard of the Journal as a scientific publication."

In view of the South Australian request that Journal Business be included on the Agenda of the Hobart Meeting, especially for discussion of the type of Journal that should be published by the Institute, it was decided to take no action on the motion till after that meeting.

Membership:

Having received the recommendation of the Branch submitting the application and of the Qualifications Committee, the following were admitted to Corporate Membership:—

Furby, E. B. (N.S.W.)
Graham, G. K. (Qld.)
Hall, I. D. (Vic.)
Herzger, Miss R. (N.S.W.)
Kilpatrick, D. T. (S.A.)
Mackie, W. B. C. (Vic.)
Osborne, H. G. A. (Vic.)
Pitney, T. J. (Vic.)
Sillcock, K. M. (Vic.)
Tesch, J. E. (Vic.)

and to Student Membership:

Arvier, A. C. (Qld.)
Brownell, P. F. (S.A.)
Jackson, E. A. (S.A.)
Lines, G. E. (S.A.)

The *resignation* of Mr. L. C. Birch was accepted with regret.

On the recommendation of the Victorian Branch the membership of Messrs. J. P. Ryland and J. F. McCrea was terminated.

Mr. W. F. Owen was granted *honorary membership* for the term of his stay abroad as a Walter and Eliza Hall Scholar.

Student Membership:

At the request of the Victorian Branch, Council considered the procedure for admission of student members.

Following discussion it was resolved, on the motion of Mr. E. J. Breakwell, seconded by Professor J. R. A. McMillan:—

"That nominations of students for student membership be approved by Council when recommended by Branch Committees. Nominees will be granted membership without submission to the Qualifications Committee."

Matters Under Consideration:

Reports are being prepared on the following items:—

Rural extension services.
Scholarships for agriculatural graduates.
Interchange of personnel.

BRANCH NOTES

AUSTRALIAN CAPITAL TERRITORY

The 73rd General Meeting of the A.C.T. Branch was held on 9th September, when a film night was held. The following films were shown:—

"The River."
"The Heredity in Animals."
"The Gift of Green."
"The Grain that Built a Hemisphere."

The 74th General Meeting was held on 24th October, when Mr. G. Downes delivered an address entitled "The study of soils in relation to land use." Mr. Downes outlined the broad field of work which could be discussed under such a title, and narrowed it down to "Pedology in Relation to Studies of Land Husbandry." The speaker reviewed the evolution and development of soil mapping systems used by the Soils Division of the C.S.I.R. which, in the first phase, was created to study in detail the soils of the irrigation areas in the Murray Valley. From the later detailed surveys of irrigation land developed the concept of the soil "Association," when it was seen that certain soil patterns in which there were dominant and minor types could be mapped as units.

Mr. Downes then discussed how soil maps could be used as a basis for land husbandry studies. The speaker concluded by stating that pedological studies in the past had been too utilitarian. The broader studies now being made enabled a better knowledge of larger areas of country and would, from a practical point of view, yield sufficient information for most purposes as well as being of more value from a theoretical point of view.

NEW SOUTH WALES

A General Meeting of the New South Wales Branch was held on 27th August, 1948. A summary of the report of the Agricultural Extension sub-committee was presented. The report, which is in five sections, covers organisation stressing the advisability of regional control and direction, training of extension officers, the need for increased personnel, finance and re-organisation of the present set-up, commencing with the establishment of two new pilot schemes at Wagga and Grafton. The report stresses the need for extension officers to be fully trained general practitioners rather than specialists, who could enlist the aid of specialists where necessary. In addition, extension officers should be fully trained in extension methods. As co-operation of the farmer is necessary if full benefit is to be obtained from extension work, it is desirable that extension officers should not have regulatory or inspectorial duties.

The following addresses were then delivered:—

"The loss of soil fertility in the New South Wales' wheat belt as reflected by depleted nitrogen content and its effect on baking quality and the condition known as mottling," by Mr. S. C. Graham.

"The use of molybdenum in controlling Whiptail," by Mr. R. D. Wilson.

"Fluorescent lighting for plant culture experiments," by Professor J. R. A. McMillan.

The meeting concluded with a screening of Stack & Co.'s interesting film on "The use of the helicopter in agriculture."

QUEENSLAND

At the regular Monthly Meeting of the Queensland Branch, held on 22nd September, 1948, details of the G. L. Sutton Prize in Agriculture (see page 201) were outlined. Summaries of the three best entries were presented by the undergraduate authors.

Mr. A. R. Bird's paper was entitled "Farming in the Monto District." This area was originally devoted to the production of beef but now cattle had given way to dairying and pigs, with peanuts as a cash crop. A remarkable feature of the district is the absence of orchards, either around the farmhouses or on a commercial scale.

Miss L. J. Brimblecombe had prepared her paper on "Flax and linseed in Australia," because of the sudden interest in linseed by farmers on the Darling Downs owing to the cessation of overseas supplies.

Mr. C. H. Clarke's paper consisted of a review of the literature on D.D.T. and benzene hexachloride and contained many items of general interest.

Following the presentation of these three papers, several members of the Branch showed exhibits to the meeting.

Mr. T. McKnight had a carefully selected range of phyllody in papaw flowers affected with yellow crinkle virus, showing all gradations from a practically normal carpel to a normal leaf with hollow petiole. The condition described is similar to that observed in plants infected by the Tomato Big Bud virus (*Lycopersicum virus* 5). Field evidence suggests that the yellow crinkle virus is identical with this virus and experiments are in progress.

Mr. J. Saint-Smith, in presenting a note on black heart of pineapples, pointed out that it has been known for years in Queensland and is always associated with

winter conditions. Attempts to isolate a causal organism have been unsuccessful and in 1941 it was found that artificially ripened fruit showed much less infection than those normally ripened. However, a repitition of this work in 1947 showed that artificial ripening was not a satisfactory method of control. Early symptoms consist of discrete areas of water-soaked tissue which soon darken and run together until nearly all the internal structure of the fruit is involved. Losses may be up to eight per cent. of the total winter intake of a cannery and the trouble has serious effects on the fresh-fruit market. Black heart can be induced in comparatively immature fruit by a sudden drop in temperature and questionnaires sent out to growers showed that they associated black heart with low temperatures and exposure to cold winds. It has been found that wind breaks do not prevent the disease and that erect fruit gives much less black heart than fallen fruit, also that in pines partly broken from the stem the disease occurrs only in the side of the fruit above the break. There is some suggestion that the cause may be nutritional in origin.

Prof. L. J. H. Teakle reported that when inspecting a soil survey being undertaken by Mr. K. D. Nicholls, of the C.S.I.R. in the Lismore district of the Northern Rivers, he saw an interesting profile in a deep cutting. He prepared quarter-scale models to explain it to the meeting. The surface soil was seen to merge into several feet of decomposing basalt over a baked soil on another layer of basalt. It was obviously the effect of a comparatively recent flow occurring over a flow which had already formed a soil.

At the conclusion of the meeting, Mr. A. F. Bell, the Federal President of the Institute, presented the Sutton Prize to Mr. Bird, and in doing so, remarked that Professor Teakle's generous donation of this annual prize should mean a lot to the Institute in that the agricultural undergraduates and seasoned workers would be given an opportunity to meet, and that the undergraduates would be given valuable experience in the preparation and presentation of papers.

VICTORIA

The Annual Dinner was held at the William Angliss Food Trades School on 30th September. Eighty-six members and friends were present. The catering, under the supervision of Chef Zimmerman, was of a particularly high order. Guests of honour included Professor J. L. Lush and Sir William Angliss.

A special general meeting of the Victorian Branch was held on 22nd October to discuss salary proposals for members employed in the Victorian Public Service. It was decided unanimously that a schedule of salary grades presented to the meeting be used in drawing up a detailed log of claims for submission to the Public Service Board. A Sub-Committee was appointed to carry this resolution into effect.

GENERAL

SPECIALIST CONFERENCE IN AGRICULTURE

The 1946 British Commonwealth Scientific Official Conference resolved that a conference of specialists should be held with the major objective of exploring problems connected with the integration of the three main branches of agricultural science, viz., soils, plants and animals, this conference to be the first of a series of Specialist Agricultural Conferences.

It was suggested that the conference should be held in Australia and the Australian Government has been happy to agree to this. Arrangements have been made accordingly to hold the conference from 22nd August to 15th September, 1949, and the Australian Council for Scientific and Industrial Research has been asked to take responsibility for the organisation of the conference.

The conference theme will be "Plant and Animal Nutrition in Relation to Soil and Climate" and it is intended that the meeting will, as far as possible, be devoted to informal discussions between workers actively engaged in research in this field. The primary object will be to focus attention on the principal gaps in our knowledge of the subject and the main problems requiring attention and to indicate how and when these can best be dealt with.

Enquiries should be directed to the Secretary, Conference Committee, Specialist Agricultural Conference, c/o C.S.I.R., 314 Albert Street, East Melbourne, Australia.

THE SUTTON PRIZE IN AGRICULTURE

This prize has recently been initiated in Queensland for the stimulation of the interest of agricultural undergraduates in research into problems of importance in this State and in Australia as a whole. It is felt that this prize, which is to be awarded annually, will continue to serve a very useful purpose in the development of scientific agriculture. The Prize has been made possible through the generosity of Professor L. J. H. Teakle, who wishes it to be known as "The Sutton Prize in Agriculture," in honour of Dr. G. L. Sutton, a brief biographical note of whom appears elsewhere in this issue.

The award is made by the Queensland Branch of the Institute. Candidates must present a paper on an agricultural topic of their own choosing. It should cover a critical examination of the literature available and may include original work. The three candidates whose papers are considered the best of those received, shall present summaries of their respective papers to a general meeting of the Branch.

Six entries were received this year and all showed evidence of a good deal of work on the part of the candidates. The best three papers were presented at the September meeting of the Branch. Mr. A. R. Bird was adjudged the winner of the prize for 1948.

C.G.H.

RETIREMENT OF DR. G. L. SUTTON

George Lowe Sutton has retired from the position of Director of Agriculture of Western Australia, after filling that position for 26 years.

Dr. Sutton was born in Liverpool, England, in 1872, and came to New South Wales in 1882. He continued his education at the Sydney High School and later took the Sydney Technical College two-year course in Agriculture, passing with honours. He then went dairy farming for several years, getting his technical guidance from a study of the scanty Australian and American literature then available. Science proved more attractive than farming and in 1900 Dr. Sutton was appointed experimentalist at the Hawkesbury Agricultural College. There he introduced new concepts into the experimental techniques of the time, including the use of control plots, the "natural" yield of plots and the expression of results as a percentage of the "natural" yield. Shortly after going to Hawkesbury he met William Farrer, which was probably the most important event of his early life, and it was not surprising that he turned seriously to plant breeding. He was selected as first manager of the Cowra farm, which was founded in 1904 to test and propagate Farrer's cross-bred wheats. Not only did he organise experiments on the farm but commenced experiments on farmers' holdings and developed the production of pedigree seed wheat to maintain the purity of varieties for commercial use.

With this background Dr. Sutton was an excellent choice for the position of Commissioner for Agriculture in the Western Australian wheat belt. He went there in 1911 in the middle of a severe drought and it was his responsibility to find the seed for many farmers whose crops had failed. There was hardly a bushel of pure seed wheat in the State. At the time of his arrival there was a move afoot to close the State farms in the wheat belt; they were most unsatisfactory as models of good farming, but Dr. Sutton, with characteristic energy and vision, had them reorganised as experimental farms, which soon became well worthy of the high public standing they attained.

Dr. Sutton was responsible for initiating the pure pedigree seed wheat scheme. He continued the wheat breeding programme with which he had been associated in New South Wales and completed the selection of Nabawa, one of Australia's greatest wheats.

He was appointed W.A. Director of Agriculture in 1922 and with graduates coming from the University, chiefly trained under Professor Paterson, of the Hackett Chair of Agriculture, he was able to implement his plans to develop a scientific department. His team was small but it made many outstanding contributions to agricultural science in Australia. The new position gave Dr. Sutton wide scope for his energy, vigour and initiative and naturally plant breeding received much of his attention. The bulk handling of wheat was advocated and the conception of the grade of "W.A. Standard White" for wheats was incorporated into the W.A. bulk handling act. Pasture development and dairying were placed on a sound footing and he played a leading part in the establishment of the Muresk Agricultural College.

It was very fitting that in April, 1947, on the eve of Dr. Sutton's retirement from the position of Director of Agriculture, the University of Western Australia conferred on him the honorary degree of Doctor of Science.

L. J. H. TEAKLE.

PERSONAL

Australian Capital Territory.

Dr. A. J. Nicholson has returned from England and Sweden, where he attended the Empire and International Science Conferences.

Mr. G. A. McIntyre has returned after study leave at Rothamsted and Cambridge University.

Mr. J. G. Crawford, Bureau of Agricultural Economics, is overseas as leader of the Australian Delegation to F.A.O.

Mr. W. T. Doig has left the Bureau of Agricultural Economics and is now in the Department of External Affairs. He is Charge Affaires at Rio de Janeiro, Brazil.

Mr. T. H. Strong has been awarded a Commonwealth Fund Fellowship and will be studying in U.S.A. for the next 18 months.

New South Wales

Dr. R. J. Swaby is expected to return shortly from England, where he has completed his studies for the Ph.D. degree at the University of London. Formerly with the N.S.W. Department of Agriculture, he will occupy the position of Senior Lecturer in General Bacteriology at the University of Sydney on his return.

Mr. W. F. Owen, Economics Research Officer, N.S.W. Department of Agriculture, has been awarded a Walter and Eliza Hall Scholarship. He left Australia in September and plans to spend one year at Oxford University and then to proceed to America. Mr. Owen was treasurer of the N.S.W. Branch of the Institute for nearly two years.

Miss Lorna Byrne, Senior Extension Officer, N.S.W. Department of Agriculture, recently married and resigned from the Service. As Mrs. S. Hayter, she commenced final leave after a long association with the Department, formerly as Women's Organiser, Agricultural Bureau of N.S.W. and latterly with the Division of Information and Extension Services. Mrs. Hayter has made a distinguished contribution to the organisation of improved services to countrywomen. She was one of the first women to graduate in Agriculture at an Australian University.

Mr. B. Doman has been appointed as Manager of the Wagga Experiment Farm. Previously he was on the tutorial staff of the Hawkesbury Agricultural College.

South Australia

Mr. J. C. Potter has been appointed Investigation Officer in Animal Husbandry at Roseworthy Agricultural College.

Mr. R. G. M. Harvey has assumed duty at Roseworthy Agricultural College as Wool Investigations Officer.

Dr. H. G. Andrewartha, of the Waite Institute, recently returned from his visit abroad. He spent three months in the United States of America and Canada, where he studied recent advances in Insect Ecology and Applied Entomology. He spent eight months at Cambridge under Dr. Wigglesworth, writing on diapause in insects. In August of this year Dr. Andrewartha attended the Eighth International Congress on Entomology at at Stockholm, Sweden.

Mr. C. G. Stephens, of the Soils Division of the C.S.I.R., has returned after extensive travels in Great Britain, United States of America, Canada and France. He attended the St. Louis Planning Conference, sponsored by the United States Department of Agriculture Soil Surveys, in April; the Tropical Soils' Conference at Rothamsted in June, and the British Soil Science Conference at Oxford in July.

Victoria

Miss M. Cowen, of the Victorian Department of Agriculture, has been appointed Seed Research Officer at the Seed Testing Station at North Palmerston, New Zealand. She left for New Zealand on 13th December.

Mr. R. S. Carne, formerly of the Victorian Department of Agriculture and now an officer of the New Guinea Department of Agriculture, Stock and Fisheries, is at present at the Imperial College of Tropical Agriculture, Trinidad, British West Indies. After the completion of his studies he will visit various tropical countries to examine those forms of agriculture most applicable to New Guinea.

Mr. F. J. R. Hird, who holds the Sir John and Lady Higgins' Research Scholarship of the University of Melbourne, left for Cambridge this month. He will continue his investigations of the proteins in pasture species under Professor Chibnall, F.R.S.

LETTERS

C.S.I.R. AND DEFENCE RESEARCH

Dear Sir,

The Executive Committee of C.S.I.R., of which Sir David Rivett is Chairman, has stated that defence research should be conducted in establishments under the appropriate authorities and that C.S.I.R. should keep to its immense programme of peace-time, non-secret industrial effort; it said it would be a lengthy task to set up defence research establishments, and in the meantime C.S.I.R. must do all it can to assist in building up the staff and equipment for defence research and in carrying out urgent work under security measures determined by the defence authorities. The Government has now introduced a Bill in which no reference whatever is made to defence research, but which gives the Government unlimited power to transfer any C.S.I.R. work to any Department and also to transfer C.S.I.R. officers to the Public Service. The reasons for this extraordinary, far-reaching measure have not been disclosed. Although Mr. Dedman has stated that the immediate intention is to transfer the Aeronautical Division, the comprehensive provisions of the Bill imply that the Government intends to transfer other Divisions, and this could be done regardless of whether their work has any relation to defence or not. If the powers proposed to be conferred by the Bill are exercised to anything like their full extent it will virtually mean the end of C.S.I.R.

The existing structure of C.S.I.R. was established after most careful consideration on the authoritative advice of leaders in science and industry. The advice given was that C.S.I.R. should be as free as possible from political control, free from departmental control, and free from Public Service control. This advice, followed successfully for over 22 years, is now for some undisclosed reason to be ruthlessly cast aside. The Government did not seek the advice of the C.S.I.R. Council on these drastic changes and did not even inform the Council of its intention to make them.

Yours, etc.,

G. LIGHTFOOT,

Member of C.S.I.R. Council.

(*Received for publication, 10th November,* 1948.)

RUBBER RESEARCH SCHEME (CEYLON)

Oidium Research Officer

Applications are invited from qualified and experienced Mycologists for the appointment of Oidium Research Officer to the Rubber Research Scheme (Ceylon).

Applicants should possess an Honours degree of a recognised university (or its equivalent) together with considerable research experience in mycology; specialist knowledge of Oidium diseases is particularly desirable and preference will be given to applicants possessing it.

The successful applicant will devote his whole time to work on all aspects of Oidium Heveae on rubber in Ceylon.

The appointment will be made in the scale Rs. 12000/- — 600/- — 25800/- (present sterling equivalent £900 — 45 — £1925) to which must be added a Dearness Allowance of Rs. 310/- per month. The commencing salary in the scale will depend upon the extent of the applicant's experience, and may be as high as £2000 per annum, inclusive of Dearness Allowance for a person of exceptional suitability.

The appointment will be for a period of 4, 3½ or 3 years depending upon age and previous service overseas and determinable by six months' notice from either side after first two years. Eight months' leave on full pay is payable at the end of the period of service.

Free furnished quarters will be provided, or a house allowance of 10% of Salary for a married officer whose wife is with him, or 5% of Salary for a bachelor, in lieu thereof.

First class, non-mail sea passages are provided to Ceylon for the officer, his wife and two children under the age of 18 years. Similar return passages are provided to the country of origin at the end of the period of service.

Leave and travelling allowances in Ceylon will be in accordance with the Scheme's regulations.

The successful applicant will be required to contribute 10% of his salary to the Provident Fund, the Board contributing a like amount.

Applications, giving an indication of the commencing salary expected, should be addressed to **The Secretary, London Advisory Committee for Rubber Research (Ceylon and Malaya), Imperial Institute, South Kensington, London, S.W.7.** A copy should be sent to the Chairman, Rubber Research Scheme, Agalawatta, Ceylon. The closing date for applications will be **28th February, 1949.**

[ADVERTISEMENT]

TOSCO

SCIENTIFIC INSTRUMENTS

A FULL RANGE AVAILABLE FOR ALL PURPOSES

- LABORATORY CENTRIFUGES by Measuring & Scientific Equipment Ltd. (Eng.), M.S.E. MINOR (as illustrated) and M.S.E. MAJOR. Both precision built throughout, with wide variable speed range. Interchangeable heads give variety of capacities for all purposes. M.S.E. Major Centrifuges incorporate an electric time switch and tachometer.

- pH METERS by N. L. Jones. For all pH and Electrometric determinations Extremely stable and reliable in performance.

- POLARISING MICROSCOPES by James Swift & Son Ltd. (England). Latest improved post-war Swift Petrological and Ore Microscopes—regular shipments arriving for stock.

M.S.E. "MAJOR" CENTRIFUGE

- PHOTOELECTRIC COLORIMETERS by Evans Electroselenium Ltd. (England). Designed by E. J. King, this Photo-electric Test Tube Colorimeter is now in wide use throughout the Commonwealth, for routine and research colorimetric analysis.

- MICROTOMES by Measuring & Scientific Equipment Ltd. (England). These are the very highest quality Microtomes for agricultural, textile, medical and industrial purposes. Our range includes the "Rotary," "Plano" (sledge-type), and the "Automatic Laboratory." Freezing attachments available.

- MOISTURE METERS by Baldwin Instrument Co. Ltd. The Baldwin N.P.L. Moisture Meter, designed in conjunction with the National Physical Laboratory, is used for moisture content findings in a wide variety of Products: Wheat, barley, rye, oats, milled products, nuts, etc.

THESE GOODS CAN BE SUPPLIED IMMEDIATELY EX STOCK

THOMAS OPTICAL & SCIENTIFIC CO. PTY. LTD.

354 LONSDALE STREET, MELBOURNE, C.1

TELEGRAMS: "THOMASOPTIC" TELEPHONE: MU 6991 (2 lines)

Microscopes stocked include models for dissecting (Binocular types), general purpose, students, and research.

Printed for the Australian Institute of Agricultural Science by Ramsay, Ware Publishing Pty. Ltd., 129 King Street, Melbourne.